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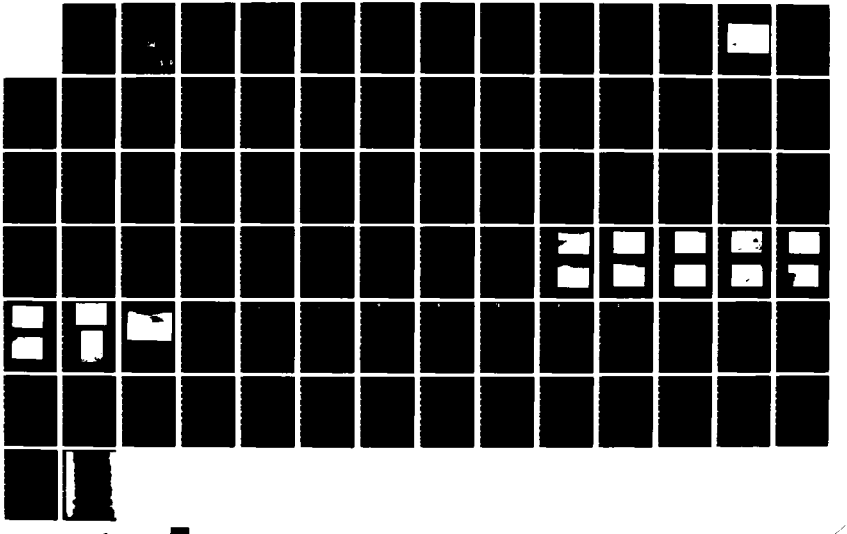

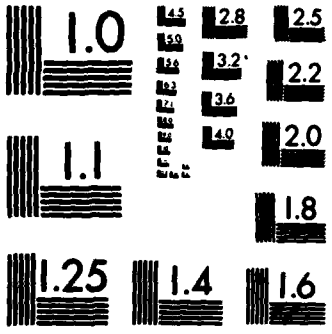

LOWER HOUSATONIC RIVER BASIN
WINCHESTER , CONNECTICUT

WINCHESTER LAKE DAM
CT 00105

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM , MASS. 02154

JANUARY 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Lower Housatonic River Basin
Winchester, Conn.
Winchester Lake Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Winchester Lake Dam is a 675 ft. long earth embankment dam with a maximum height of 23 ft. The top width of the dam is 14 ft. The upstream embankment slope is 2.5:1 and is protected with riprap below the water surface. The downstream slope is 2:1. The spillway is 25 ft. wide. The dam and its appurtenances were judged to be in generally fair condition. The capacity of the spillway is adequate to pass the ½ PMF spillway test flood outflow with a freeboard of 0.7 ft.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

MAY 01 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Winchester Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, Dept. of Environmental Protection, Hartford, Connecticut,.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

WINCHESTER LAKE DAM

CT 00105

LOWER HOUSATONIC RIVER BASIN

WINCHESTER, CONNECTICUT

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	CT 00105
Name of Dam:	Winchester Lake Dam
Town:	Winchester
County and State:	Litchfield, Connecticut
Stream:	East Branch Naugatuck River
Date of Inspection:	25 October, 1979

BRIEF ASSESSMENT

Winchester Lake Dam is a 675-foot long earth embankment dam with a maximum height of 23 feet. The top width of the dam is 14 feet. The upstream embankment slope is 2.5:1 and is protected with riprap below the water surface. The downstream slope is 2:1. The spillway is 25 feet wide, located at the right side of the dam. A 24-inch diameter cast iron pipe under the center of the dam provides a low level outlet.

The lake is open to the public and used for recreational purposes. Winchester Lake has a storage volume of 3,120 acre-feet; the size classification is thus intermediate. A breach of the dam would affect about 5 single-family homes, located between 2 and 4 miles downstream of the dam. The first 2 miles of the valley downstream of the dam is completely rural, with no structures, and 3 minor roads that cross the valley. About 4 miles downstream of Winchester Lake, its discharge waters enter the storage reservoir of the Corps of Engineers' flood control dam, on the East Branch of the Naugatuck River (East Branch Dam). The dam has been classified as having a significant hazard potential.

The dam and its appurtenances were judged to be in generally fair condition. The dam embankment is overgrown with extensive vegetation on both the upstream and downstream faces. Many large trees are in the vicinity of the toe of the slope. General erosion and sloughing of the slopes were noted. A 3-inch pipe was discharging a significant quantity of clear water at the toe of the slope adjacent to the blow-off location. The slope in this vicinity was wet and spongy. The upstream face has riprap in good condition; however, the upper 7 feet of the slope is not protected. Erosion has occurred on both sides of the spillway structure.

The capacity of the spillway is adequate to pass the 1/2 PMF spillway test flood outflow with a freeboard of 0.7 feet.

Within one year of receipt of the Phase I Inspection Report, the owner, the State of Connecticut, should engage a qualified

registered engineer to: 1) investigate the seepage at the downstream toe and design appropriate remedial measures; 2) design procedure for repairing erosion at the downstream toe of the dam in the vicinity of the spillway channel and measures for diverting the flow away from the toe of the dam; 3) design procedures for clearing trees and brush and their root systems from the dam and the area immediately downstream of the toe of the dam, and for properly backfilling the areas where the roots were removed; 4) design repairs for displaced riprap on upstream slope and determine need to extend the riprap to the crest; 5) design method of repairing areas of sloughing on the upstream slope and crest to restore these areas to original grade consistent with the design drawings noted in Section 2; and 6) investigate feasibility of providing control for blow off pipe upstream of core wall.

The owner should also carry out the following operational and maintenance procedures: 1) maintain clear of trees and brush the dam embankment, an area within 50 feet of the downstream toe, and a zone 25 feet on either side of the spillway channel for a distance of 100 feet downstream from the dam; 2) develop method of preventing trespassing on the dam crest and slopes; 3) engage a qualified registered engineer to make a comprehensive technical inspection once every year; and 4) establish a surveillance program for use during and immediately after heavy rainfall and also a warning program to follow in case of emergency conditions.

S. Giavara

S. Giavara, P.E.
President

Registered, CT. 7634

This Phase I Inspection Report on Winchester Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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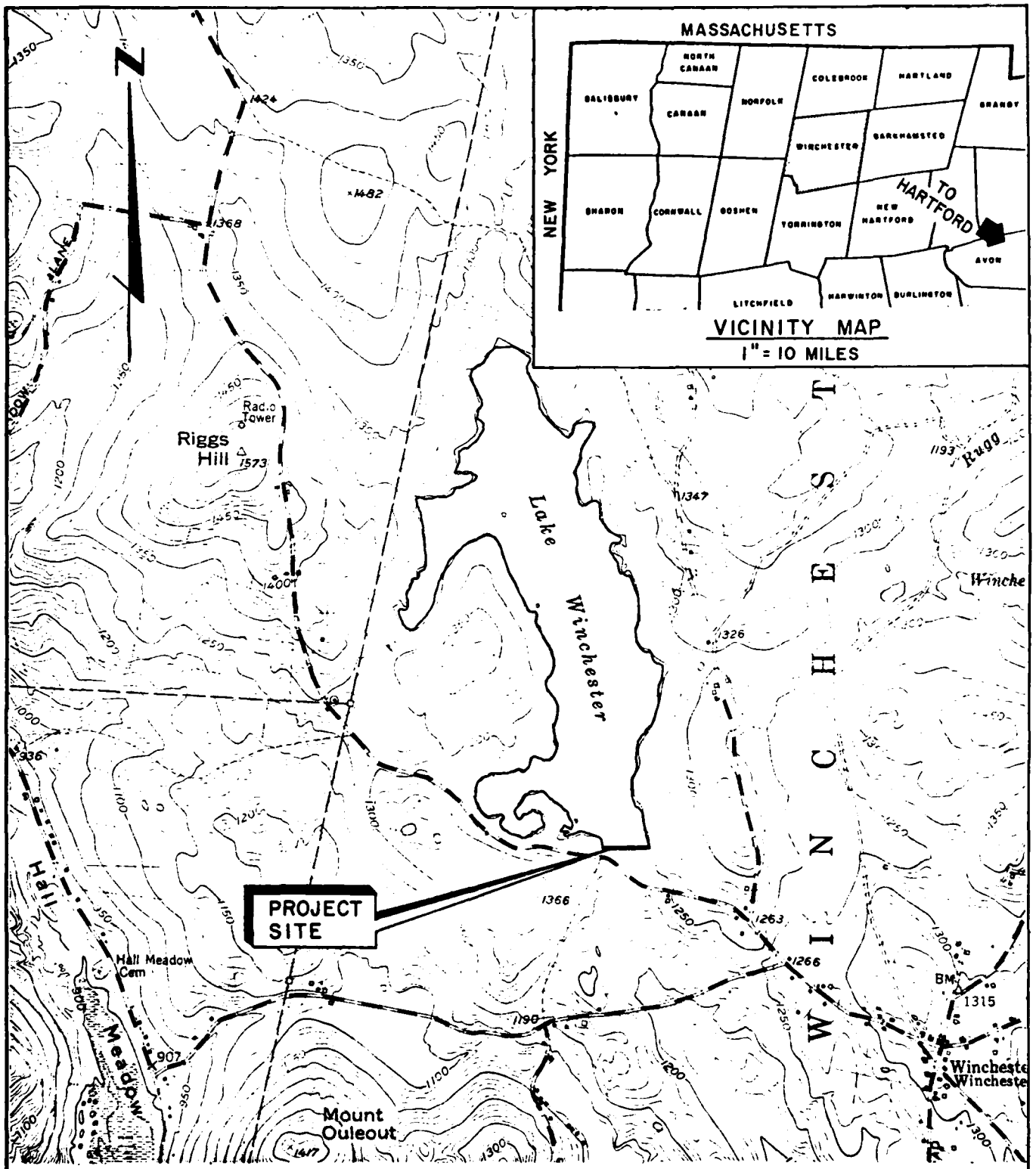
Overview Photo: Lake Winchester Dam



WINCHESTER LAKE DAM

LOCATION MAP

WINCHESTER, CONNECTICUT

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
WINCHESTER LAKE DAM - CT 00105

SECTION I - PROJECT INFORMATION

1.1 GENERAL:

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection through the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Flaherty Giavara Associates, P.C. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Flaherty Giavara Associates, P.C. under a letter of 19 October, 1979, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0001 has been assigned by the Corps of Engineers for this work.

b. Purpose.

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and assist the States to initiate quickly effective dam safety programs for non-federal dams.

3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF THE PROJECT

a. Location. The Winchester Lake Dam is located in Winchester, Connecticut, on the East Branch of the Naugatuck River. The dam is located approximately one mile northwest of Winchester Center. The dam is shown on the U.S.G.S. Topographic Map "Norfolk, Connecticut" at a latitude of 41°54'25" and a longitude of 73°08'35". The Location Map on page vi shows the location of the structure.

b. Description of Dam and Appurtenances. Winchester Lake Dam is a 675 foot long earth embankment dam with a maximum height of 23 feet. The dam embankment elevation is 120.0 feet and the normal lake elevation is 116.0 feet. These elevations are based on construction plan of the dam which used an assumed datum. The top width of the embankment is 14 feet. The upstream embankment slope is 2.5 horizontal to 1 vertical and is faced with riprap below the

water surface level. The downstream earth embankment slope is 2 horizontal to 1 vertical. The construction plans indicate a concrete core wall varying from 2.5 to 4.5 feet thick along the entire length of the earth embankment. The maximum elevation of this wall is shown as 118.5 feet.

The spillway consists of a concrete gravity section and training walls with a 25 foot width. It is located near the right (west) abutment. The spillway crest has provisions for flashboards. The outlet works consist of a 24-inch diameter cast iron pipe under the center of the dam serving as the low level outlet. The control gate is located in a manhole at the crest of the dam which extends down to the outlet pipe. The construction plans indicate that the outlet pipe was placed on a concrete foundation.

c. Size Classification. Winchester Lake has a storage volume of 3,120 acre-feet and a dam height of 23 feet. Storage of more than 1,000 acre-feet classifies this structure in the "intermediate" category according to guidelines established by the Corps of Engineers.

d. Hazard Classifications. The dam is classified as having a "significant" hazard potential. The first two miles of the valley downstream of the dam is completely rural, with no structures, and only three minor roads cross the valley. Below this section to the East Branch Dam owned and operated by the Corps of Engineers less than ten residential homes would be subject to flooding due to a dam failure. The dam has been classified as having a significant hazard potential since there is possibility of some loss of life and appreciable economic loss would result from failure, including damage to isolated homes, rural roads, and notable agricultural land.

e. Ownership. This dam and lake are owned by the Connecticut Department of Environmental Protection, Division of Conservation and Preservation, 165 Capital Avenue, Hartford, Connecticut; Dennis P. DeCarli, Deputy Commissioner; telephone: 566-4522. The dam was previously owned by the Torrington Electric Light Company, Torrington, Connecticut.

f. Operator. The dam is operated by the Connecticut Department of Environmental Protection, Division of Conservation and Preservation, Burr Pond State Park, Mr. Warren Whitney, telephone: 379-0771.

g. Purpose of Dam. The dam and lake are open to the public and used for recreational purposes. A state boat launching facility is located on the lake.

h. Design and Construction History. The dam was designed and construction supervised by Mr. William G. Smith, Civil Engineer, from Waterbury, Connecticut, in 1927. The construction plans

for the dam were approved by Mr. A. B. Hill, Engineer for the State Board of Dams. Construction drawings that include a plan view, profile, and typical cross section are included in Appendix B. The drawings show information regarding the foundation conditions at the site. In 1942 the State Board of Supervision of Dams approved the installation of flashboards on the dam spillway. The flashboards were one foot high.

i. Normal Operation Procedures. The lake water level is maintained at the dam spillway crest elevation. Annually the outlet works gates and conduit are opened for testing purposes to ensure proper operation.

1.3 PERTINENT DATA:

a. Drainage Area: The drainage area consists of 2.19 square miles of rolling to hilly terrain, which is forested and undeveloped. The watershed is 12,000 feet in length and 8,000 feet wide.

b. Discharge at Dam Site.

1) The outlet works consist of a 24-inch diameter cast iron conduit under the center of the dam. The conduit is operated by a gate mechanism located in a manhole at the embankment crest. The outlet conduit's invert elevation at its inlet and outlet is 97± feet. The capacity of the outlet conduit with the lake water level at 116.0 is 68 CFS.

2) Available past flood records at the dam were obtained from the files of the Connecticut Department of Environmental Protection. Correspondence from the former State Board of Supervision of Dams, dated May 29, 1942, states that the maximum observed depth of flow over the spillway was 8 inches. This is computed to be a discharge of 48 CFS.

3) The ungated spillway capacity at the top of dam - 700 CFS at EL. 120.0.

4) The ungated spillway capacity at test flood elevation - 537 CFS at EL. 119.3.

5) The gated spillway capacity at normal pool elevation is not applicable at this dam.

6) The gated spillway capacity at test flood elevation is not applicable at this dam.

7) The total spillway capacity at test flood elevation - 537 CFS at EL. 119.3.

8) The total project discharge at the top of dam is not applicable.

9) The total project discharge at test flood elevation - 537 CFS at EL. 119.3.

c. Elevation. (Elevations from construction plans.)

1) Streambed at toe of dam ..... 97±

2) Bottom of core wall ..... 83±

3) Maximum tailwater ..... N/A

4) Recreational pool 116.0

5) Full flood control pool ..... N/A

6) Spillway crest 116.0

7) Design surcharge (Original Design) ..... unknown

8) Top of dam 120.0

9) Test flood design surcharge 119.3

d. Reservoir. (Length in feet)

1) Normal pool ..... 7,400±

2) Flood control pool ..... N/A

3) Spillway crest pool ..... 7,400±

4) Top of dam ..... 7,450±

5) Test flood pool ..... 7,445±

e. Storage. (Acre-feet)

1) Normal pool 2,280

2) Flood control pool ..... N/A

3) Spillway crest pool 2,280

4) Top of dam 3,120

5) Test flood pool 2,840

f. Reservoir Surface. (Acres)

1) Normal pool 250

2) Flood control pool ..... N/A

3) Spillway crest 250

4) Test flood pool 275

5) Top of dam 280

g. Dam.

1)	Type:	Earth embankment with concrete gravity spillway section.
2)	Length:	675 feet.
3)	Height:	23 feet.
4)	Top Width:	14 feet.
5)	Side Slopes	Upstream: 2.5 horizontal to 1 vertical. Downstream: 2.0 horizontal to 1 vertical.
6)	Zoning:	Unknown.
7)	Impervious Core:	Concrete core wall.
8)	Cutoff	None.
9)	Grout curtain:	None.

h. Diversion and Regulating Tunnel.

1) Type ..... N/A

2) Length ..... N/A

3) Closure ..... N/A

4) Access ..... N/A

5) Regulating Facilities ..... N/A

i. Spillway.

1)	Type:	Concrete gravity spillway "ogee" crest.
2)	Length of weir:	25 feet
3)	Crest elevation:	116.0 feet

4)	Gates:	No.
5)	U/S Channel:	Reservoir.
6)	D/S Channel:	Natural stream channel.

j. Regulating Outlets.

1)	Invert:	97± feet.
2)	Size:	24 inch.
3)	Description:	Conduit through dam.
4)	Control mechanism:	Valve gate within manhole at crest of dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No data on the design of the dam and its appurtenances have been recovered. An inspection report has been included in Appendix B.

2.2 CONSTRUCTION:

A drawing showing a plan view of the dam, a section through the proposed dam and a profile developed to show bedrock depths along the longitudinal axis at the dam (dated 1927) are the only known construction information available. This plan is included in Appendix B.

2.3 OPERATION:

Operation of the dam by the State DEP is on an informal basis to satisfy the recreational interests of lake users.

2.4 EVALUATION:

a. Availability. The only engineering data available are the construction plans described above.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. The field investigation indicated that the external features of Winchester Lake Dam agree with those shown on the available plans.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

a. General. Winchester Lake Dam is an earthen embankment about 23 feet high, 675 feet long and 14 feet wide at the crest. The dam and its appurtenances were judged to be in generally fair condition. The dam embankment is overgrown with extensive vegetation on both the upstream and downstream faces. Many large trees are in the vicinity of the toe of slope. General erosion and sloughing of the slopes were noted. A 3-inch pipe was discharging a significant quantity of clear water at the toe of slope adjacent to the blow-off location. The slope in this vicinity was wet and spongy. The upstream face has riprap in good condition; however, the upper 7 feet of the slope is not protected. Erosion has occurred on both sides of the spillway structure.

b. Dam.

1) Upstream slope - Most of the upstream face of the dam is covered with vegetation and small trees,as shown in Photo No. 1. In the vicinity of Station 4+80, sloughing and erosion of the slope adjacent to the crest have occurred, as shown in Photo No. 9. Riprap has been displaced at many locations along the upstream and generally only extends 2 feet above the water surface. Erosion has occurred adjacent to the left spillway wingwall as indicated in Photo No. 10.

2) Crest - The crest of the dam is covered with grass and some brush, seen in Photos No. 2 and 3. Several small trees are growing along the upstream edge of the crest as indicated in Photo No. 4. There is a worn footpath extending along the entire crest, as shown in Photo No. 2. The design drawing, dated 1927, indicated a central concrete core wall. However, the presence of this core wall was not confirmed during the site visit.

3) Downstream slope - The downstream slope of the dam was covered with extensive vegetation, brush and small trees, as shown in Photos No. 3, 4 and 5. There is a worn path along the downstream slope which is adjacent to the right spillway wingwall. This path is approximately 3 feet wide and up to 12 inches deep near the crest. There is another sizeable erosion path along the downstream slope at Station 1+60. The path at this location is 4 feet wide and up to 18 inches deep. Rock stairs adjacent to the left spillway wingwall are shown in Photo No. 14.

There is an existing tree growth along the downstream toe, seen in Photos No. 3,4 and 5.

At Station 4+0, a large tree has fallen over about 20 feet downstream from the toe. The exposed tree root system can be seen

in Photo No. 6. A 3-inch diameter pipe which was discharging clear water was located adjacent to the 24-inch blowoff at the toe of the slope near Station 4+70, shown in Photo No. 7. No additional discharge pipes were observed during the site visit. The design drawing does not indicate the existence of a toe drain system.

To the left of the blowoff valve, the ground at the toe of the dam was wet and soggy, as shown in Photo No. 8.

The spillway channel flows adjacent to the downstream toe at the contact with the left spillway training wall, as indicated in Photo No. 12. Erosion of the downstream toe at this location is evident.

c. Appurtenant Structures.

1) Spillway - The concrete training walls are in excellent condition with only a few minor surface cracks noted. The training walls are vertical with no indication of misalignment or movement. (Photos No. 1 and 11)

The sloping downstream face of the concrete spillway is in good condition. Some surface deterioration has occurred and exposed coarse aggregate was noted on the surface.

The crest of the spillway is equipped with 2-inch diameter metal pipe posts and 12-inch high metal channel brackets to accommodate flashboards. Flashboards were not in place at the time of the inspection.

A tree trunk was lodged across the spillway during the inspection.

The visible portion of the 21-foot long concrete apron at the toe of the spillway is in good condition and is effectively preventing scour at the toe of the spillway. The downstream end of the apron rests on boulders or bedrock and is stable.

2) Outlet works - A 24-inch diameter cast iron pipe under the center of the dam provides a low level outlet (blow-off). The pipe terminates at a concrete endwall, apron, and wingwalls. All concrete is in excellent condition. The outlet pipe was found to be in generally good condition. The control gate is located in a manhole easily located at the crest of the dam. The blow-off pipe was dry and clear of debris. The outlet is operated on an annual basis.

3) Spillway discharge channel - The outflow from the spillway follows a channel parallel to the toe of the dam to the original river channel near Station 4+50. The constructed channel has a natural bed and banks. Riprap is in place at the junction of the spillway apron and the discharge channel. The bed of the

channel contains many cobbles and boulders and is generally stable and clear.

In the vicinity of Station 4+00 several large trees have blown over and are obstructing flow in the channel (Photo No. 6). The flow has been deflected by the root system and is shifting the stream's alignment closer to the toe of the dam.

d. Reservoir Area. The land around the perimeter of the reservoir has moderate slopes and is completely wooded. There is no evidence of slides or unstable slope conditions (Photo No. 15).

The reservoir did not have any visible sediment deposits. There are no significant point sources of sediment in the watershed, due to its rural forest condition.

e. Downstream Channel. The river channel downstream of the dam (below its junction with the spillway discharge channel) varies in width from 8 to 15 feet. It has a natural bed and banks, and flows through a wooded area, as shown in Photo No. 13. It appears to be stable, with no degradation or aggradation noted.

3.2 EVALUATION:

Based on the visual inspection, Winchester Lake Dam is in fair condition.

There is an area of seepage on both sides of the blow off outlet structure. The seepage to the right of the blow off may be the exit of a foundation drain. These seepages could result in piping and erosion of the foundation and/or embankment of the dam.

Serious erosion is occurring at the downstream toe of the embankment, near the intersection with the left spillway training wall. If allowed to continue, it could lead to undercutting the embankment at that location.

Sloughing of the upstream face of the embankment at several locations implies that the embankment may be susceptible to piping or slope stability failure.

Small trees are now growing on parts of the upstream and downstream slopes and larger trees in the area downstream of the toe of the dam. If allowed to grow, they may blow over and pull out their roots, or may die and thus lead to rotting of their roots. In either case, serious erosion and seepage problems could result. Brush growing in these areas make it difficult to inspect the dam and downstream toe adequately.

Trespassing has led to the development of several bare paths from

the crest to the toe of the downstream slope. These conditions lead to erosion problems and failure if not remedied.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES:

a. General. The Connecticut Department of Environmental Protection operates the dam. There appear to be no formal operating procedures. The 24-inch blow-off for the dam is operated annually to ensure proper operation if required in an emergency.

b. Description of any warning system in effect. No warning system is in effect at Winchester Lake Dam.

4.2 MAINTENANCE PROCEDURES:

a. General. Normal maintenance consists of annual grass mowing along the crest of the earth embankment and brush cutting.

b. Operating facilities. There are no formal maintenance procedures followed for the operating facilities.

4.3 EVALUATION:

Regular operational maintenance procedures for this dam and its appurtenances have not been developed or implemented.

An emergency action plan should be prepared to prevent or minimize the impact of failure. This plan should list the expedient action to be taken and authorities to be contacted.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL:

The Winchester Lake Dam is a 675-foot long earth embankment structure that impounds about 2,280 acre-feet to the crest of the spillway and 3,120 acre-feet to the top of the dam. The spillway is capable of discharging about 700 CFS with surcharge to the top of the dam.

The watershed consists of 2.19 square miles of rolling to hilly terrain. The watershed is almost totally forested, and is in a rural area containing few structures of any kind. There are no significant water impoundments upstream of the dam.

5.2 DESIGN DATA:

No data has been recovered on the hydraulic/hydrologic criteria used in the design of the dam.

5.3 EXPERIENCE DATA:

No records are available in regard to past operation of the reservoir or of outflow through the spillway. The maximum past inflows are unknown. A letter report (dated May 29, 1942) indicated that the maximum observed depth of flow over the spillway was 8 inches (50 CFS). The period of record included the major hurricanes of 1936 and 1938. Since 1974 the depth of flow has not been enough to monitor (conversation with operator).

5.4 TEST FLOOD ANALYSIS:

The test flood for determining the spillway adequacy is based upon OCE guidelines. The size classification of the dam is "intermediate", based on a storage volume of 3,120 acre-feet. The hazard potential is "significant". The recommended spillway test flood in the Corps of Engineers guidelines for this size dam and hazard potential ranges from 1/2 PMF to the full PMF. The spillway test flood selected for evaluating the adequacy of the dam is the 1/2 PMF. The 1/2 PMF was selected because of the low level of development along the floodplain downstream of the dam.

The magnitude of the PMF (and thence the 1/2 PMF spillway test flood) is based upon "Preliminary Guidance for Estimating PMF Discharge" by the New England Division, Corps of Engineers, dated December, 1977. The watershed is rolling, without significant upland floodwater storage areas. Therefore, the flood magnitude is based on the "Rolling" watershed curve. The PMF is

4600 CFS. The spillway test flood is 2300 CFS.

The spillway test flood was formed into a triangular hydrograph with a peak of 2300 CFS and a duration of 12 hours. The duration was set so that the triangular hydrograph would contain the same volume of water as the estimated storm runoff.

The hydrograph was routed through the reservoir using a computer program based on stage-storage and stage-discharge data. The reservoir was assumed to be full and level with the spillway prior to the storm event.

The results of the flood routing procedure indicated that the spillway test flood would have a flood stage at elevation 119.3 (0.7 feet below the top of the dam), with a peak discharge of 537 CFS. The reservoir storage would be about 881 acre-feet and provide a major reduction in flow rates down stream. The spillway is capable of discharging the spillway test flood without overtopping. (Compare 537 CFS to 700 CFS.)

5.5 DAM FAILURE ANALYSIS:

The downstream impact of a dam failure was analyzed using the Corps of Engineers' "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", dated April, 1978. Based upon an assumed breach width equal to 40% of the dam's width at mid-height, the peak flood flow leaving the dam would be 44,420 CFS, with an initial depth of 11.6 feet downstream of the dam. The flood flow rate and flow depth decreases slowly as it passes downstream. This is due to a narrow valley and the high storage volume in the reservoir.

The height of the downstream flood wave is typically 10 to 15 feet, and the width of the flooded portion of the valley is about 500 feet. The first 2 miles of the valley downstream of the dam is completely rural, with no structures, and only 3 minor roads cross the valley. About 5 single-family homes, located between 2 and 4 miles downstream of the dam, would be subject to flooding due to the dam failure. At two houses the depth of flooding would be about 5 feet and the remaining houses would be subjected to water depths of 2 feet or less.

At approximately 4 miles downstream of Winchester Lake, its discharge waters enter the storage reservoir of a Corps of Engineers flood control dam on the East Branch of the Naugatuck River (East Branch Dam). The peak flow of the assumed Winchester Lake Dam failure was determined to be 21,900 CFS at the East Branch Dam, which is greater than the 15,500 CFS probable maximum flood inflow calculated for this dam. However, the PMF design flood for the East Branch Project had an inflow volume of 11,000 acre-feet. Therefore, the Winchester dam failure inflow volume of about 3,000 acre-feet should not exceed the surcharge storage-spillway capacity of the East Branch Project.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS:

The visual inspection did not disclose any evidence of present structural instability. However, the following potential structural stability problems were indicated:

a. The areas of seepage noted in the vicinity of the blow-off structure could result in piping and erosion of the foundation and/or embankment of the dam.

b. Erosion is occurring at the downstream toe of the embankment near the intersection with the left spillway training wall, and could lead to undercutting of the embankment at that location.

6.2 DESIGN AND CONSTRUCTION DATA:

No design and construction data are available; therefore a formal evaluation of stability could not be performed.

6.3 POST-CONSTRUCTION CHANGES:

No information is available relative to post-construction changes insofar as they are pertinent to the embankment or foundations.

6.4 SEISMIC STABILITY:

The dam is located in Seismic Zone 2 and, in accordance with recommended guidelines of the Corps of Engineers, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

a. Condition. On the basis of the visual inspection and a review of available data, the dam is judged to be in fair condition. The long-term performance of the dam could possibly be affected by seepage in the vicinity of the blowoff valve and by continued erosion of the toe of the dam to the left of the spillway structure.

The capacity of the spillway is adequate to pass the 1/2 PMF test flood outflow of 537 CFS with a free board of 0.7 feet.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection, past performance history and sound engineering judgement.

c. Urgency. The recommendations presented in Sections 7.2 and 7.3 should be carried out within one year after receipt of this Phase I report.

7.2 RECOMMENDATIONS:

The owner should engage a qualified registered engineer to:

1) Investigate the seepage at the downstream toe and design appropriate remedial measures.

2) Design procedure for repairing erosion at the downstream toe of the dam in the vicinity of the spillway channel and measures for diverting the flow away from the toe of the dam.

3) Design procedures for clearing trees and brush and their root systems from the dam and the area immediately downstream of the toe of the dam, and for properly backfilling the areas where the roots were removed.

4) Design repairs for the erosion of the banks of the channel downstream from the spillway structure.

5) Design repairs for displaced riprap on upstream slope and determine need to extend to crest.

6) Design method of repairing areas of sloughing on the upstream slope and crest to restore these areas to original grade consistent with the design drawings noted in Section 2.

7) Investigate feasibility of providing control for blow off pipe upstream of core wall.

7.3 REMEDIAL MEASURES:

a. Operating and Maintenance Procedures. The owner should:

1) Maintain clear of trees and brush the dam embankment, an area with 50 feet of the downstream toe and a zone 25 feet on either side of the spillway channel for a distance of 100 feet downstream from the dam.

2) Develop method to prevent trespassing on the dam crest and slopes.

3) Engage a qualified registered engineer to make a comprehensive technical inspection once every year after the recommendations made in 7.2 have been carried out.

4) Establish a surveillance program for use during and immediately after heavy rainfall and also a warning program to follow in case of emergency conditions.

7.4 ALTERNATIVES:

There are no practical alternatives to the recommendations presented in Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Winchester Lake Dam

DATE Oct. 25, 1979

TIME 0930

WEATHER Overcast, 50°F

W.S. ELEV.____ U.S.____DN.S.

PARTY:

1. R. Smith, FGA, Project Manager
2. J. MacBroom, FGA, Hydraulics/Hydrology
3. R. Murdock, GEI, Geotechnical
4.
5.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT	Not applicable.
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Not applicable.
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	Not visible, underwater.
Condition of Concrete	
Stop Logs and Slots	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	Not applicable.
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	Not applicable.
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Good.
Rust or Staining	None observed.
Spalling	No.
Erosion or Cavitation	No.
Visible Reinforcing	No.
Any Seepage or Efflorescence	No.
Condition at Joints	Good.
Drain Holes	None.
Channel	
Loose Rock or Trees Overhanging Channel	Natural channel bottom, some trees on both sides.
Condition of Discharge Channel	Good.

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Underwater upstream face of dam.
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Generally good condition.
Rust or Staining	None.
Spalling	Some minor spalling and erosion.
Any Visible Reinforcing	None observed.
Any Seepage or Efflorescence	None.
Drain Holes	None.
c. Discharge Channel	
General Condition	Fair.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Trees on both sides of channel.
Floor of Channel	Natural bottom, boulders and bedrock.
Other Obstructions	Trees fallen into channel, vegetative growth, uprooted stumps.

PERIODIC INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Winchester Lake Dam DATE: Oct. 25, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	Not applicable.
a. Superstructure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat and Backwall	

APPENDIX B

ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM WINCHESTER LAKE DAM

I.D. NO. CT-00105

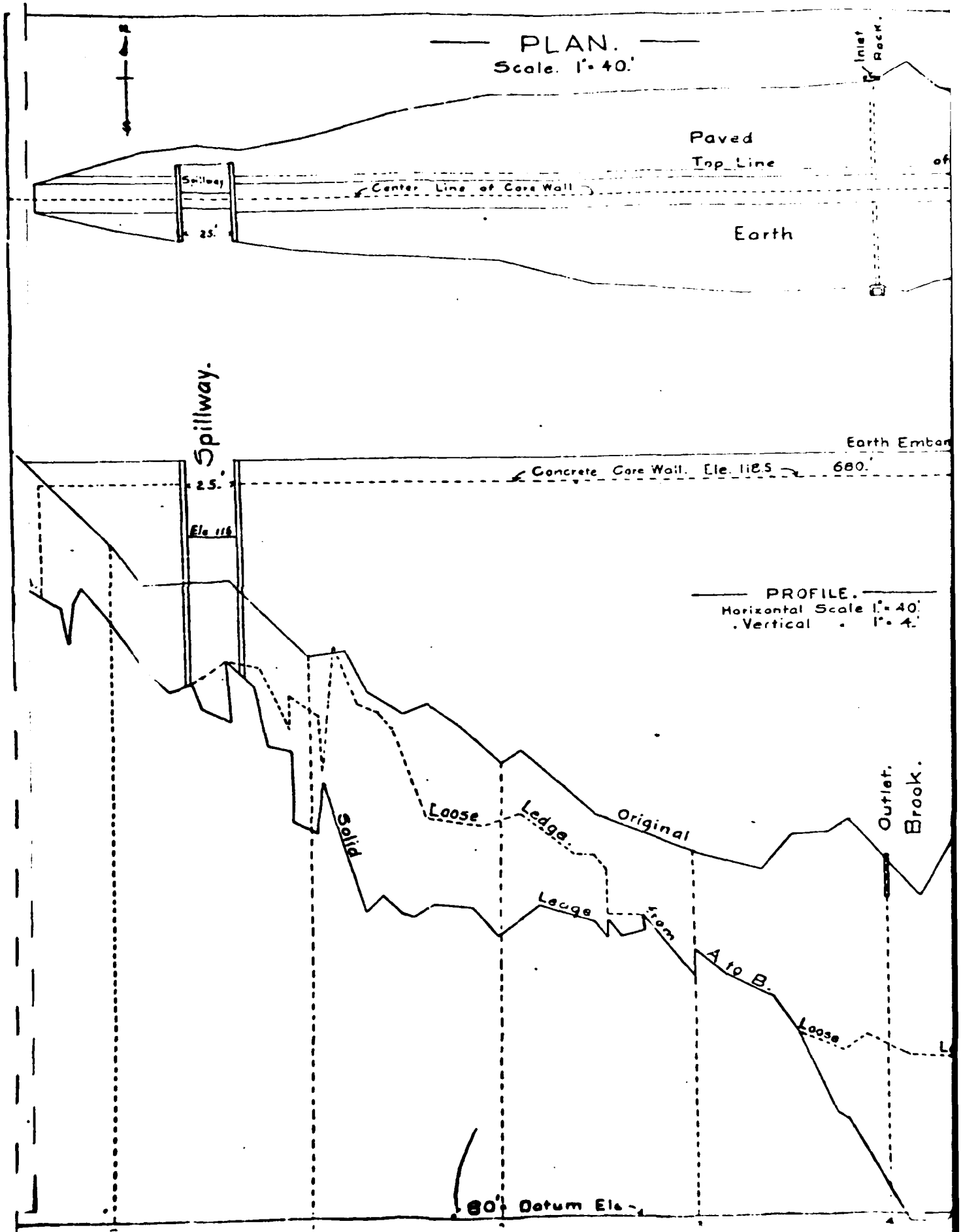
ITEM	REMARKS
AS-BUILT DRAWINGS	NONE EXIST
REGIONAL VICINITY MAP	AVAILABLE FROM U.S.G.S.
CONSTRUCTION HISTORY	NONE AVAILABLE
TYPICAL SECTIONS OF DAM	FROM PLANS
OUTLETS - Plan	FROM PLANS
- Details	FROM PLANS
- Constraints	UNKNOWN
- Discharge Ratings	NONE AVAILABLE
RAINFALL/RESERVOIR RECORDS	UNAVAILABLE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS	
HYDROLOGY & HYDRAULICS	NONE
DAM STABILITY	NONE
SEEPAGE STUDIES	NONE
MATERIALS INVESTIGATIONS	
BORINGS RECORDS	NONE - SECTION ON PLANS SHOWS BEDROCK ELEVATIONS
LABORATORY	NONE
FIELD	NONE

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

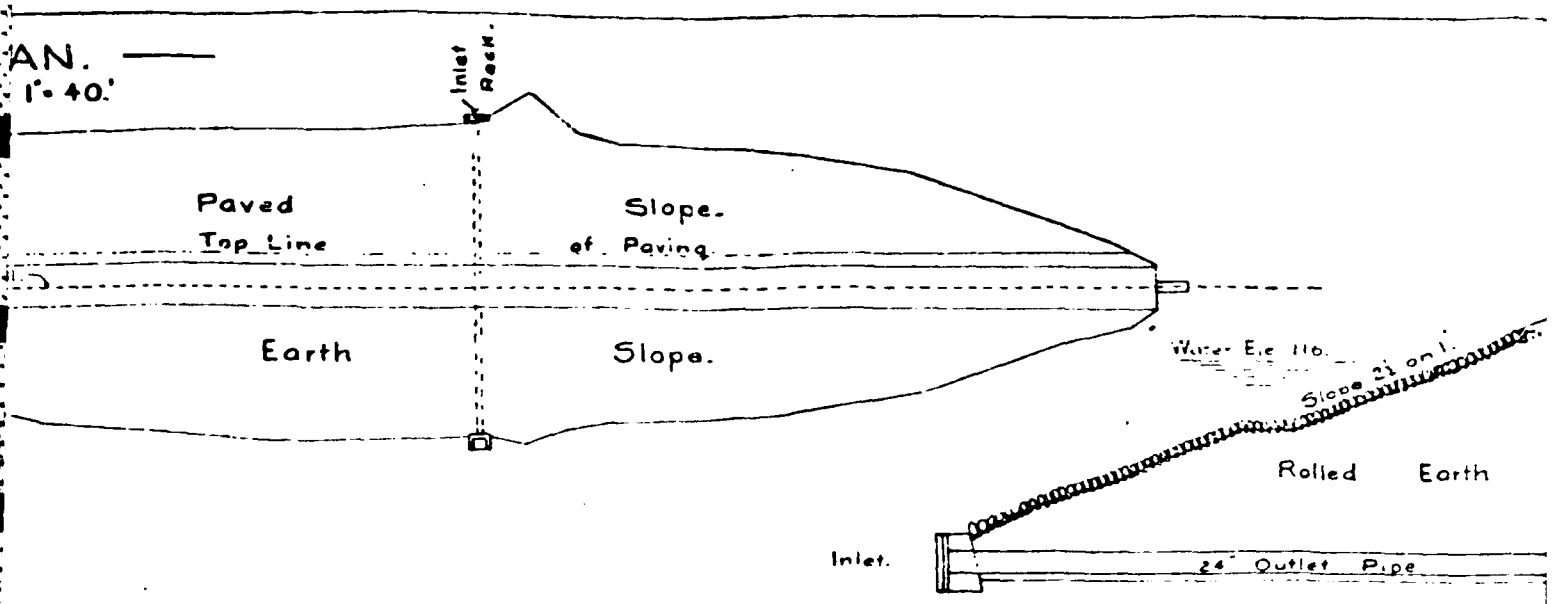
NAME OF DAM WINCHESTER LAKE DAM

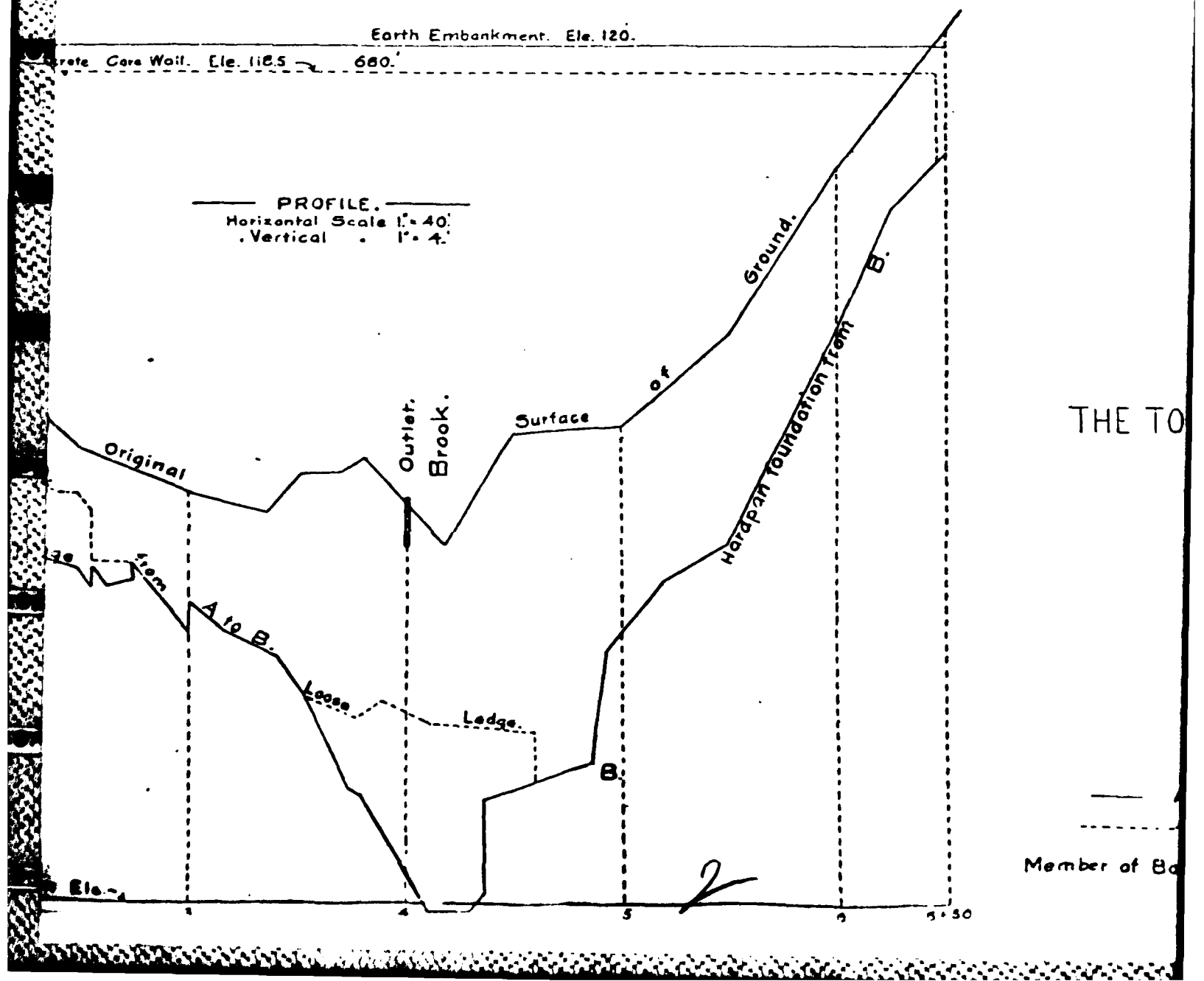
I.D. NO. CT-00105

ITEM	REMARKS
POST-CONSTRUCTION SURVEYS OF DAM	NONE AVAILABLE
BORROW SOURCES	UNKNOWN
MONITORING SYSTEMS	NONE
MODIFICATIONS	UNKNOWN
HIGH POOL RECORDS	NONE
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	UNKNOWN
PRIOR ACCIDENTS OR FAILURE OF DAM	
DESCRIPTION	NONE
REPORTS	NONE
MAINTENANCE OPERATION RECORDS	NONE
SPILLWAY PLAN	
SECTIONS	FROM PLANS
DETAILS	FROM PLANS
OPERATING EQUIPMENT PLANS & DETAILS	FROM PLANS


PLAN.
Scale. 1" = 40'
Inlet Rock.
Paved
Top Line
of
Spillway
Center Line of Core Wall
25'
Earth
Spillway.
Earth Embankment
Concrete Core Wall. Ele. 118.5
680'
25'
Ele 116
PROFILE.
Horizontal Scale 1" = 40'
Vertical " = 4'
Solid
Loose
Ledge
Original
Outlet Brook.
Ledge
from A to B.
Loose
80' Datum Ele.

AN. ——
1" = 40'





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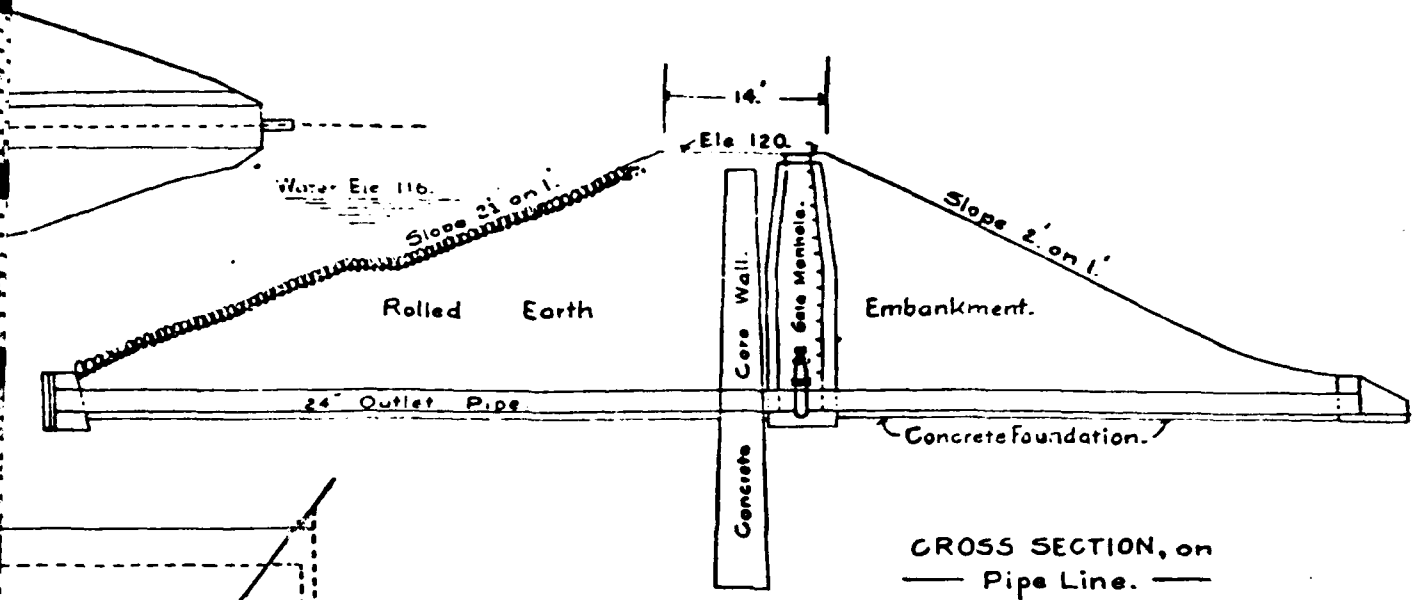
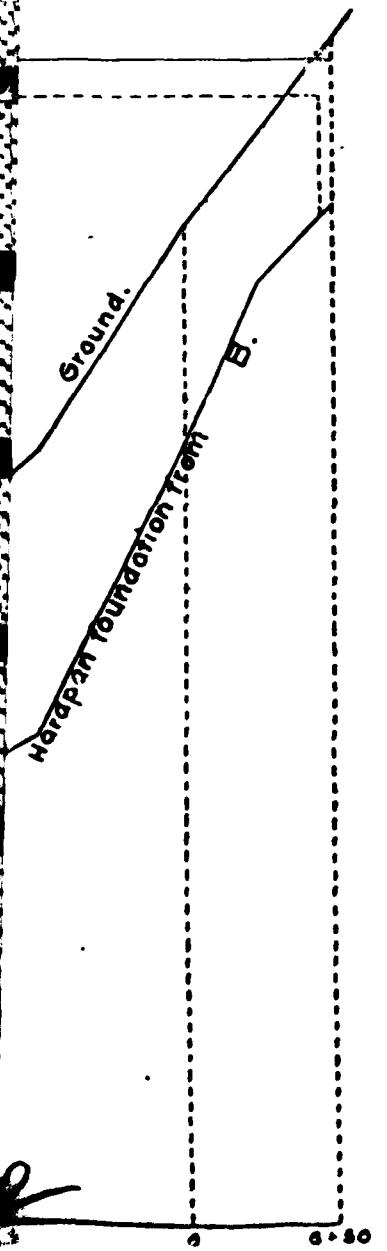
Member of Bo



CROSS SECTION, on
— Pipe Line. —
Scale. 1"= 10'



THE TORRINGTON ELECTRIC LIGHT COMPAN
PLAN and PROFILE.

Winchester. Dam.

Town of Winchester.

1927.

Wm G. Smith.
Civil Engineer.
Waterbury. Conn

— Approved. —

Member of Board of Civil Engineers.

3

REDUCED NOT TO SCALE

A. J. MACCHI • ENGINEERS
DR. GIULIO PIZZETTI — ASSOCIATE CONSULTANT

44 GILLETT STREET — HARTFORD, CONN. — PHONE 525-6631
7 CORSO DUCA ABRUZZI — TORINO, ITALY — PHONE 519-473

N.S.E. — A.S.C.E. — A.C.I.

June 18, 1962

Water Resources Commission
State of Connecticut
State Office Building
165 Capitol Avenue
Hartford, Connecticut

Re: Winchester Lake & Park Pond
Winchester, Conn.

Gentlemen:

Reference is made to your letter of June 13, 1962 regarding dams at the above locations. Mr. H. R. Hoffman of this office and myself inspected these sites on June 16, 1962 and our findings are as follows:

1) Winchester Lake

Dam and spillway are both in good condition and should be free of major repairs in the immediate future. It is suggested that if this property is acquired that small brush growth on the dam be cut down to facilitate future inspection.

2) Park Pond

Dam and spillway are both in good condition and should also be free of major repairs in the immediate future. At present spillway is partially obstructed with several tree trunks and driftwood which should be cleared out.

Very truly yours,

A. J. MACCHI, ENGINEERS

A. J. MACCHI

Fish + Game (Hanover)
6-19-62

161-1-3

STATE BOARD OF SUPERVISION OF DAMS
Room 317 State Office Bldg.,
Hartford, Conn.

May 29, 1942 V. B. Clarke

Mr. Clarence H. Blair
Consulting Engineer
100 Crown Street,
New Haven, Conn.

Dear Mr. Blair:

At your request I examined with you the Winchester Dam of the Torrington Electric Light Company, on May 18th, 1942, on account of the request to install flash boards on this dam.

According to the records that have been furnished me, this dam was built in 1927, being designed and supervised by the late Mr. William G. Smith, of Waterbury, and the plans approved at that time by Mr. A. B. Hill, Engineer for the State Board.

From observations made on the date of our visit and from the statement of the caretaker the watershed for this pond appears to have an exceptionally slow run off. The day previous to our visit there had been about 3½ inches of rain-fall within 24 hours and there was only about 4 inches of water going over the dam. I understood the caretaker to say that 6 inches was the maximum he had seen.

Permission is therefore granted to install flash boards not over 1 foot high and suggest that you have them

installed in such a manner that if occasion should arise they could be removed during a period of exceptionally heavy flow.

Very truly yours,

(signed) V. B. Clarke

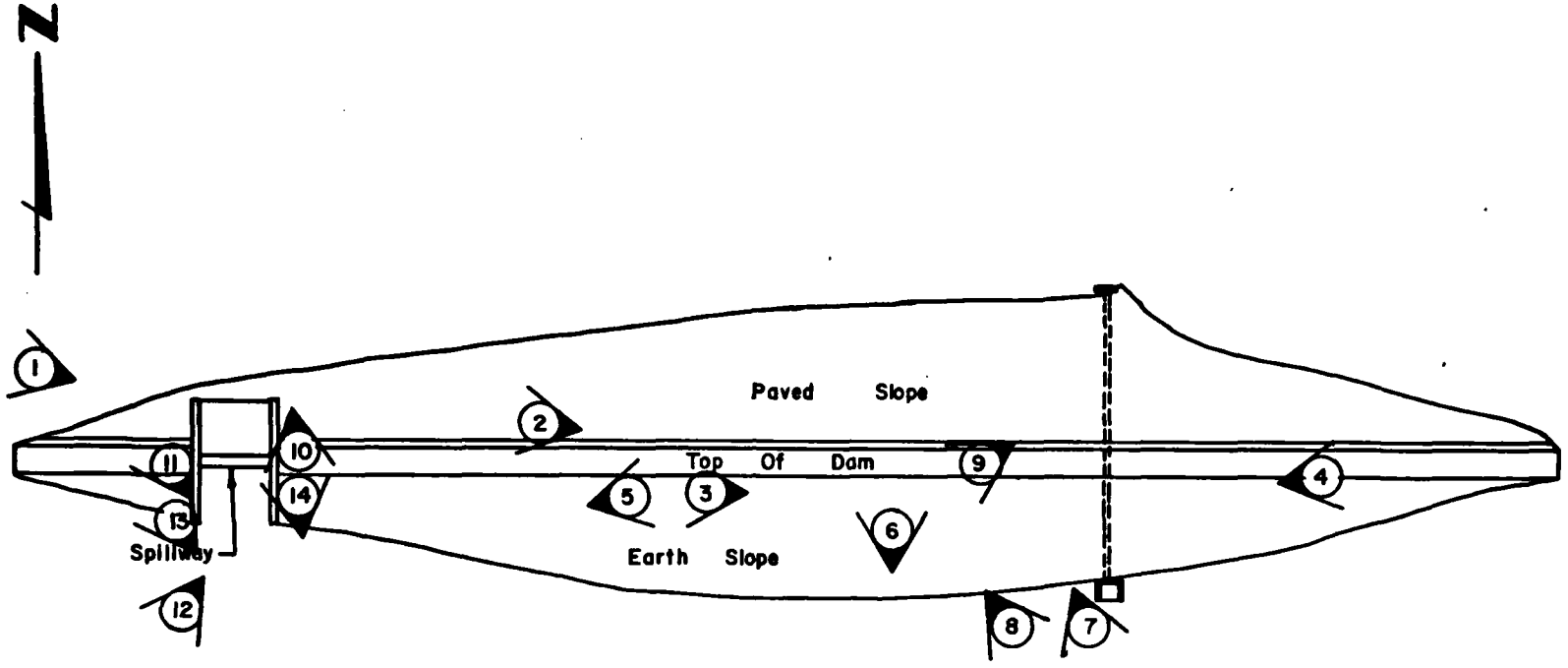
Engineer, for
The State Board of Supervision of Dams

VBC:M

Copy to: Gen. S. H. Wadhams.

APPENDIX C

PHOTOGRAPHS



LEGEND

5 Number refers to caption. Arrow indicates direction of photograph.

WINCHESTER LAKE DAM
PHOTO LOCATION MAP

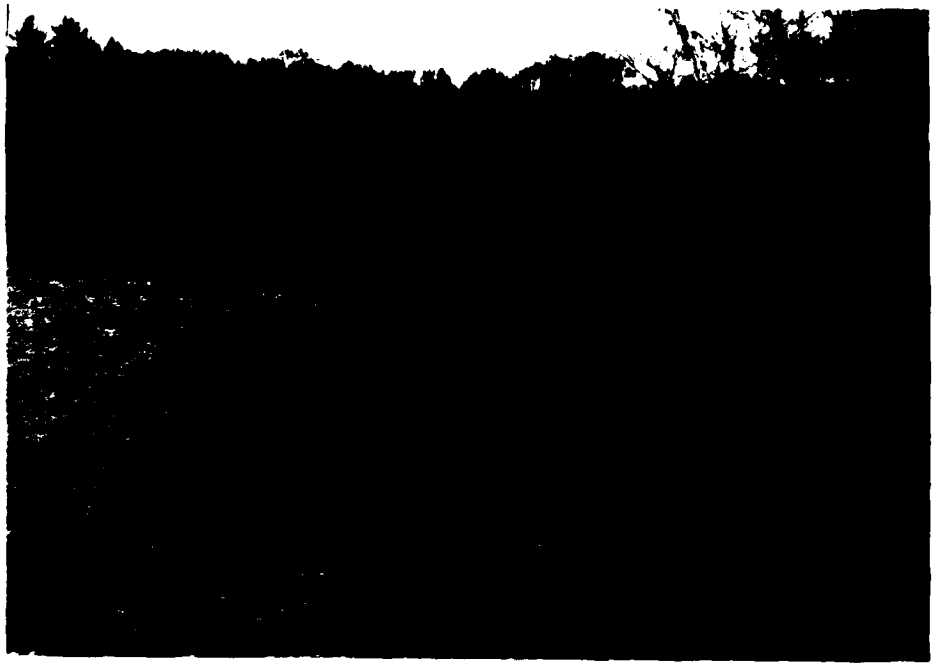


PHOTO #1: Upstream face of dam looking toward left abutment.

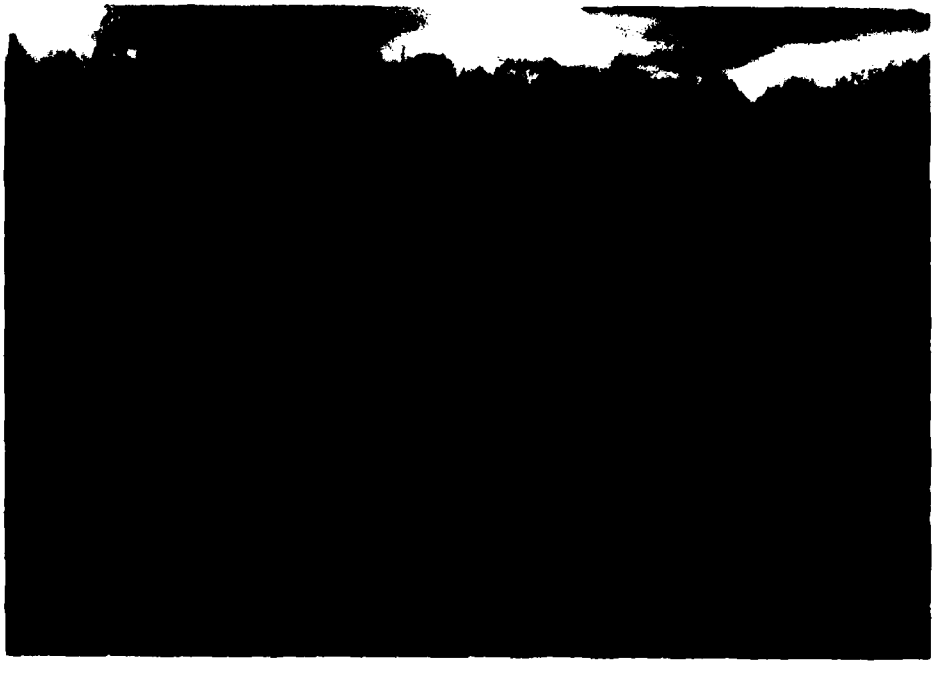


PHOTO #2: Crest of dam looking toward left abutment.

PHOTO #3: Crest and downstream slope of dam looking toward left abutment.

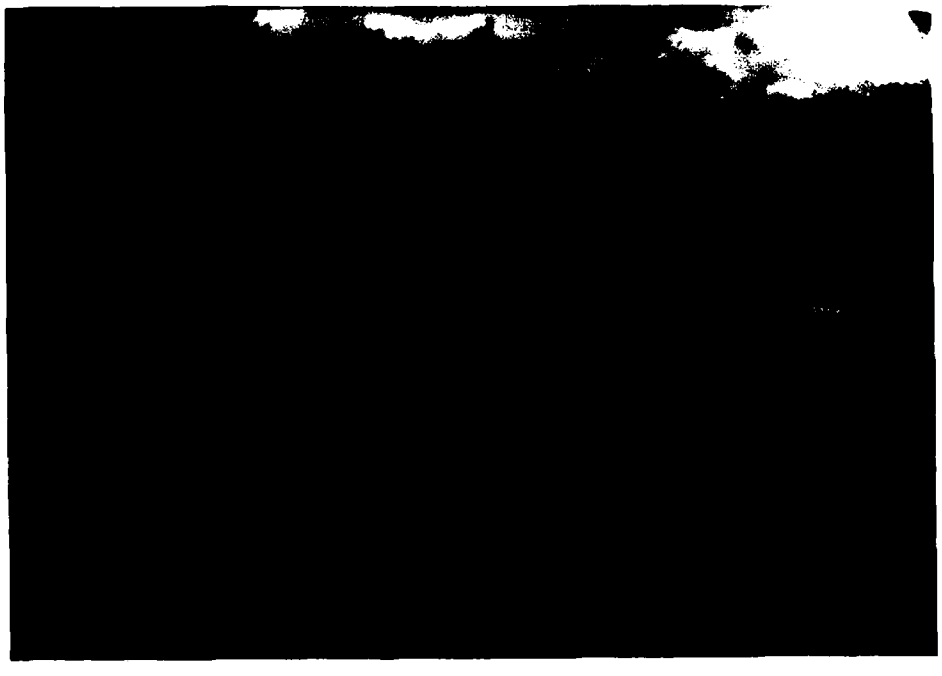


PHOTO #4: Crest and downstream slope of dam looking toward right abutment.

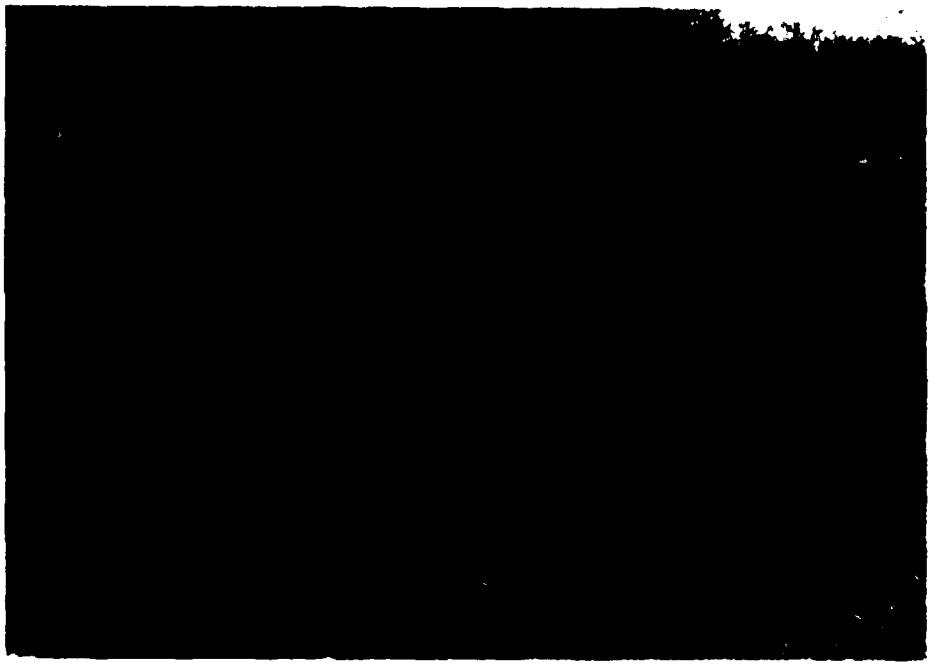


PHOTO #5: Looking downstream from crest of dam.

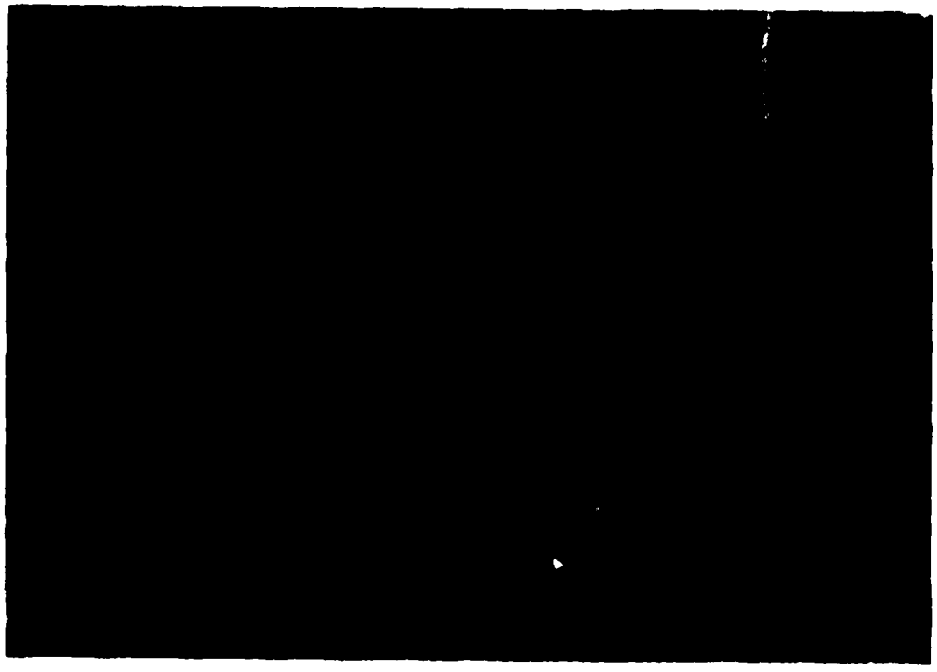


PHOTO #6: Looking along downstream slope toward toe, large tree uprooted approx. 20 ft. downstream of toe.

PHOTO #7: Flow emanating from 3-inch pipe near toe of slope.

PHOTO #8: Ground wet and soggy at toe of slope.

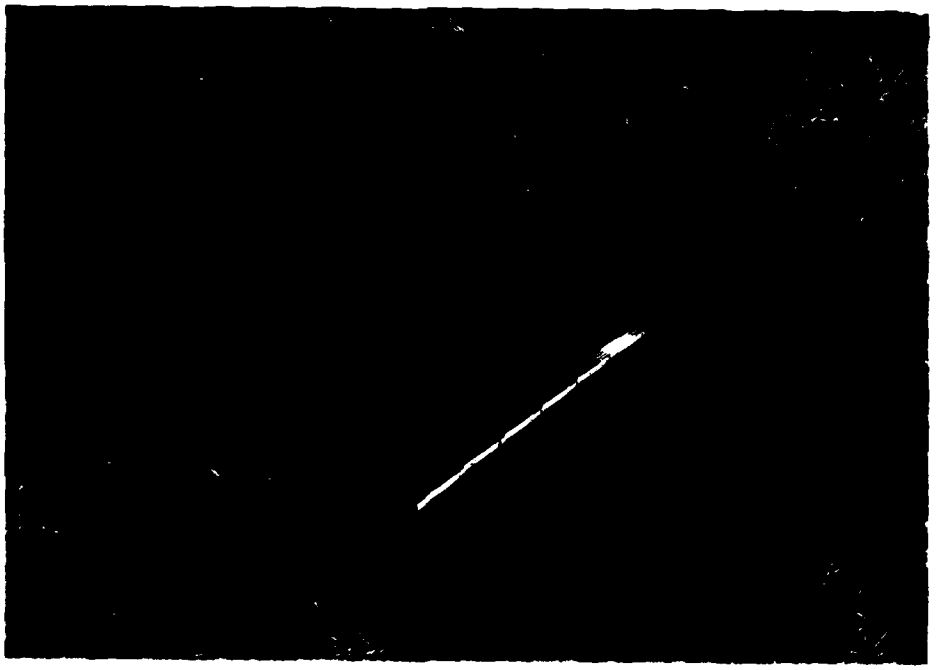


PHOTO #9: Area of sloughing and erosion on upstream face, approximately 5 ft. wide, up to 8 in. deep. (Rule extended 3 ft.)

PHOTO #10: Erosion area adjacent to spillway wing-wall on upstream slope. (Rule extended 2 ft.)

PHOTO #11: Looking at downstream toe, near intersection of left spillway training wall.

PHOTO #12: Downstream from spillway channel looking upstream. Note erosion and undermining of the toe.

PHOTO #13: Looking downstream along spillway channel.

PHOTO #14: Looking downstream along embankment; rock stairs adjacent to spillway wingwall.

PHOTO #15: Reservoir Area.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

PROJECT
WINCHESTER LAKE DAM
WINCHESTER, CT

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

SHEET NO. 1 OF 22
BY JGM DATE 12/7/79
CHK'D. BY [illegible] DATE [illegible]

DETERMINATION OF SPILLWAY TEST FLOOD*

A. SIZE CLASSIFICATION

Storage Volume (Ac.-Ft.) 3061

Height of Dam (Ft.) 23

Size Classification INTERMEDIATE

B. HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life	Economic Loss
Low	None expected	Minimal
Significant	(Few)	(Appreciable)
High	More than few	Excessive

Hazard Classification SIGNIFICANT

C. HYDROLOGIC EVALUATION GUIDELINES

Hazard	Size	Spillway Design Flood
Low	Small	50 to 100-Year Frequency
	Intermediate	100-Year Frequency to 1/2 PMF
	Large	1/2 PMF to PMF
(Significant)	Small	100-Year Frequency to 1/2 PMF
	(Intermediate)	(1/2 PMF to PMF)
	Large	PMF
High	Small	1/2 PMF to PMF
	Intermediate	PMF
	Large	PMF

Spillway Test Flood 1/2 PMF

*Based upon "Recommended Guidelines for Safety Inspection of Dams" Department of the Army, Office of the Chief of Engineers, November 1976.

PROJECT
WINCHESTER LAKE
WINCHESTER, CT

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

SHEET NO. 2 OF 22
BY JGM DATE 12/7/79
CHK'D. BY PB DATE 12/20/79

DETERMINATION OF THE

MAXIMUM PROBABLE FLOOD (MPF)

A. Drainage Area in Square Miles 2.19

B. Watershed Characteristic: Flat & Coastal

(Rolling)

Moutainous

C. M.P.F. in CFS/Square Mile,* 2100

M.P.F. = (CFS/Square Mile) x (Area in Square Miles)

2100 x 2.19 = 4600 CFS

1/2 PMF = 1/2 (4600) CFS = 2300 CFS

*Based upon the figure "Maximum Probable Flood Peak Flow Rates" U.S. Army Corps of Engineers, December 1977.

VOLUME OF RUNOFF FOR THE TEST FLOOD

BASED UPON AN ASSUMED "CN" VALUE OF 75 (FOR GLACIAL TILL SOILS), THE PMP RUNOFF IS 19.0 INCHES (FIG A-4, DESIGN OF SMALL DAMS).

ASSUME RUNOFF FOR 1/2 PMF = RUNOFF FOR 1/2 PMP

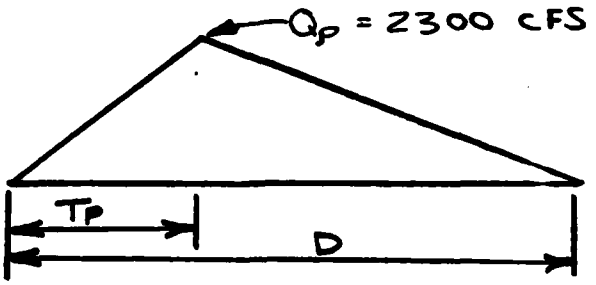
SO SPILLWAY TEST FLOOD RUNOFF = 1/2 PMP RUNOFF

VOLUME OF RUNOFF = 2.19 SQ miles × 640 AC. × $\frac{9.5"}{12"}$

= 1109 AC-FT

TEST FLOOD HYDROGRAPH

A TRIANGULAR HYDROGRAPH IS TO BE USED TO ROUTE THE TEST FLOOD THROUGH THE RESERVOIR. THE HYDROGRAPH PEAK IS AT 2300 CFS. THE DURATION OF THE HYDROGRAPH IS SET SO AS TO CONTAIN THE ABOVE (1109 AC-FT) VOLUME OF RUNOFF. THE LENGTH OF THE RECEEDING LIMB IS TWICE THE RISING LIMB.



FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

HYDROGRAPH VOLUME = $\frac{1}{2}(Q_p)(D) = 1109$ AC-FT

$$D = \frac{1109 \text{ AC-FT}}{\frac{1}{2} Q_P}$$

$$D = \frac{1109 \text{ AC-FT} \times 43560 \text{ FT}^3/\text{AC-FT}}{2300 \text{ CFS} \times 0.5 \times 60 \text{ S/M} \times 60 \text{ M/HR}} = 11.7 \text{ HOURS}$$

SAY D = 12 HOURS, T_p = 4 HOURS

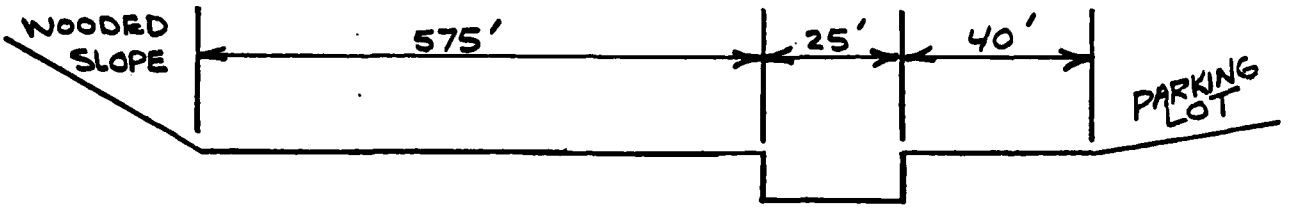
HYDROGRAPH FORMATION

Q_p = 2300 CFS
T_p = 4.0 HRS
D = 12.0 HRS

TIME HOURS	INFLOW CFS
0	0
1	575
2	1150
3	1725
4	2300
5	2012
6	1725
7	1437
8	1150
9	863
10	575
11	288
12	0

SPILLWAY AND OVERFLOW SECTION DATA

N.T.S.



SEGMENT	ITEM	"C"	LENGTH	ELEV
1	GRASS CREST OF EARTH DAM	2.5	575'	1253
2	OGEE CREST SPILLWAY	3.5	25'	1249
3	GRASS CREST OF EARTH DAM	2.5	40'	1253

STAGE DISCHARGE DATA

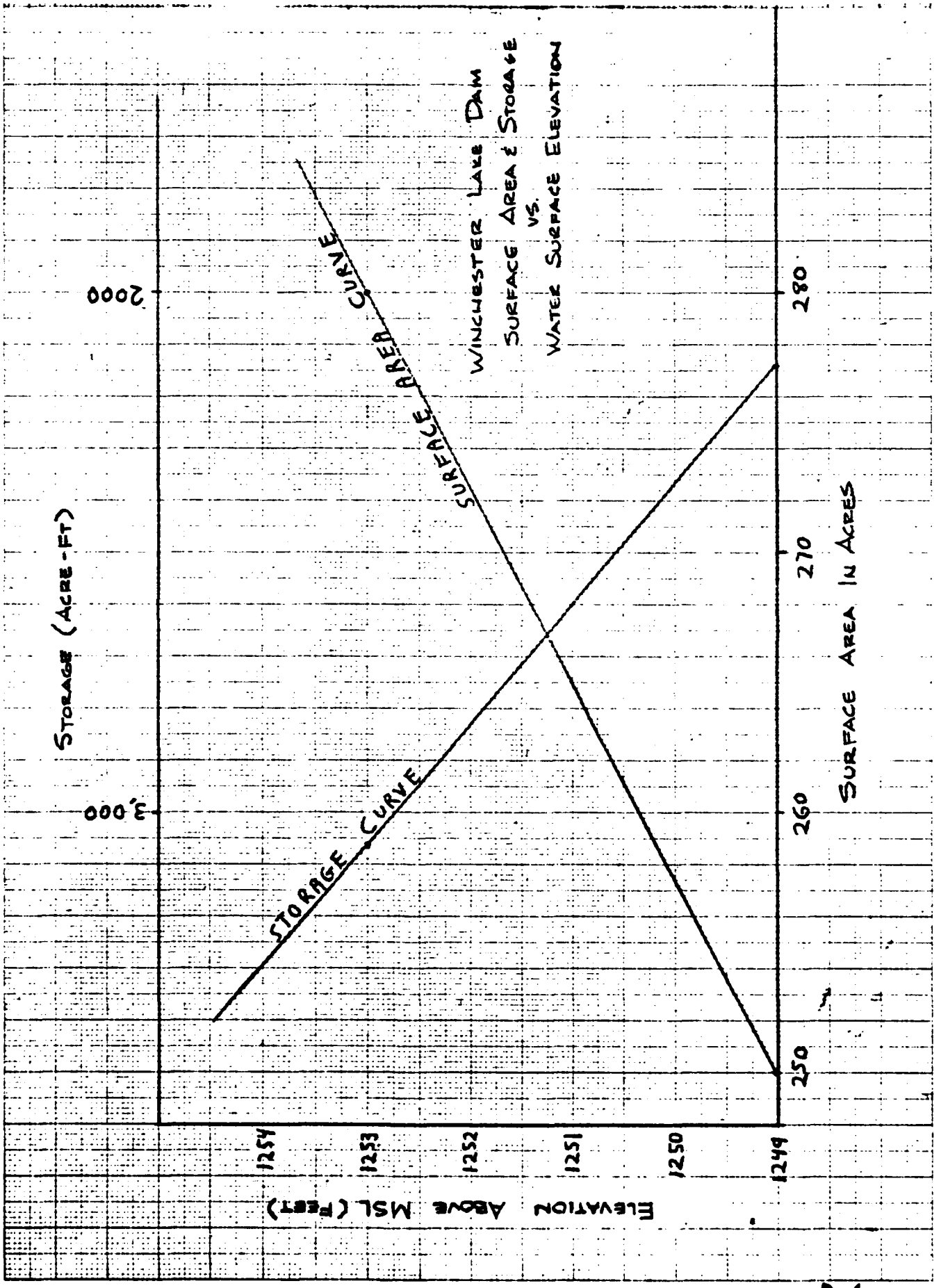
$$Q = CLH^{3/2} = C_1L_1H_1^{3/2} + C_2L_2H_2^{3/2} + C_3L_3H_3^{3/2}$$
$$= C_{1,3}(L_1+L_3)H_{1,3}^{3/2} + C_2L_2H_2^{3/2}$$

STAGE	H_1, H_3	Q_1+Q_3	H_2	Q_2	Q_{TOTAL}
1249			0		
1250			1	87.5	87.5
1251			2	247	247
1252			3	455	455
1253	0		4	700	700
1254	1	1537	5	978	2515
1255	2	4347	6	1286	5633
1256	3	7986	7	1621	9607

PROJECT: WINCHESTER LAKE DAM

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1260

SHEET NO. 6 OF 22
BY DKS DATE 12/14/79
CHK'D. BY PB DATE 12/14/79



PROJECT: WINCHESTER LAKE DAM

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
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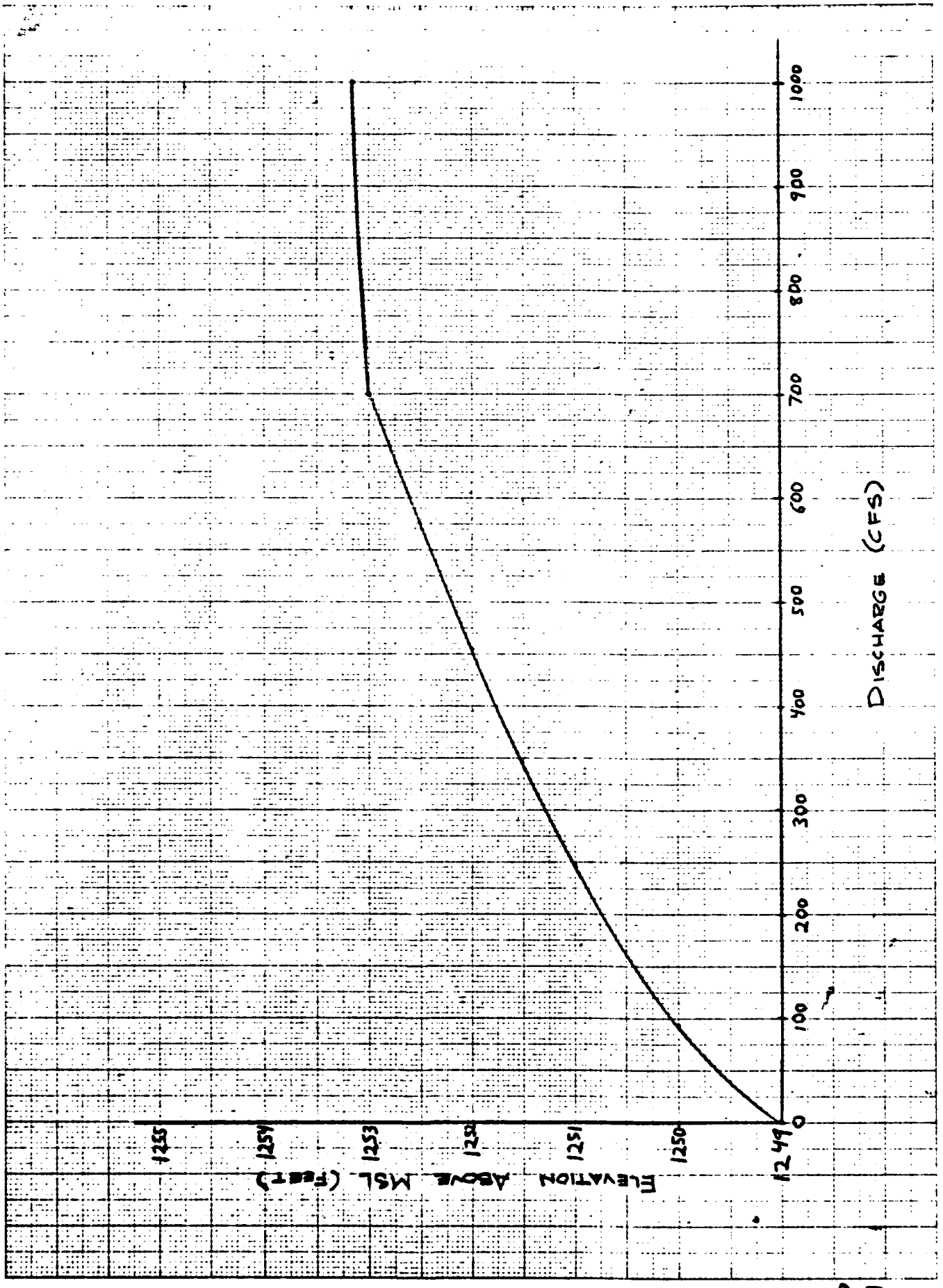
SHEET NO. 7 OF 22
BY DKS DATE 12/14/79
CHK'D. BY PB DATE 12/14/79



WINCHESTER LAKE DAM 79-90-10 FLOOD ROUTING DKS 12/12/79

zZ

INPUT DATA: UNSUBMERGED WEIR
SEGMENT 1 DISCHARGE COEFFICIENT = 2.5 LENGTH OF WEIR = 575 ELEVATION OF WEIR = 253
SEGMENT 2 DISCHARGE COEFFICIENT = 3.5 LENGTH OF WEIR = 25 ELEVATION OF WEIR = 249
SEGMENT 3 DISCHARGE COEFFICIENT = 2.5 LENGTH OF WEIR = 40 ELEVATION OF WEIR = 253
IE=249.0 IV= 0.0 E=249.0 A=250.00 E=260.0 A=333.00

HOUR	INFLOW	MASS INFLOW	WATER EL.	TAIL WATER	OUTFLOW	MASS OUTFLOW	STORAGE(R)	STORAGE(A)
0.00	0CFS	0.00AC-F	249.00FT	.00FT	0CFS	0.00AC-F	0.00AC-F	0.00AC-F
1.00	575CFS	23.76AC-F	249.09FT	0.00FT	2CFS	0.10AC-F	23.65AC-F	23.65AC-F
2.00	1,150CFS	95.04AC-F	249.37FT	0.00FT	20CFS	1.03AC-F	94.00AC-F	94.00AC-F
3.00	1,725CFS	213.84AC-F	249.82FT	0.00FT	65CFS	4.58AC-F	209.26AC-F	209.26AC-F
4.00	2,300CFS	380.16AC-F	250.43FT	0.00FT	150CFS	13.51AC-F	366.64AC-F	366.64AC-F
5.00	2,012CFS	558.34AC-F	251.04FT	0.00FT	256CFS	30.33AC-F	528.00AC-F	528.00AC-F
6.00	1,725CFS	712.76AC-F	251.53FT	0.00FT	352CFS	55.51AC-F	657.25AC-F	657.25AC-F
7.00	1,437CFS	843.42AC-F	251.89FT	0.00FT	431CFS	87.89AC-F	755.53AC-F	755.53AC-F
8.00	1,150CFS	950.33AC-F	252.14FT	0.00FT	488CFS	125.90AC-F	824.42AC-F	824.42AC-F
9.00	863CFS	1,033.51AC-F	252.29FT	0.00FT	524CFS	167.76AC-F	865.74AC-F	865.74AC-F
10.00	575CFS	1,092.93AC-F	252.35FT	0.00FT	537CFS	211.65AC-F	881.28AC-F	881.28AC-F
11.00	288CFS	1,128.59AC-F	252.32FT	0.00FT	530CFS	255.79AC-F	872.80AC-F	872.80AC-F
12.00	0CFS	1,140.49AC-F	252.21FT	0.00FT	503CFS	298.52AC-F	841.97AC-F	841.97AC-F
15.00	0CFS	1,140.49AC-F	251.79FT	0.00FT	409CFS	411.71AC-F	728.78AC-F	728.78AC-F
20.00	0CFS	1,140.49AC-F	251.25FT	0.00FT	296CFS	557.50AC-F	582.98AC-F	582.98AC-F

WINCHESTER LAKE DAM 79-90-1 DKS 12/12/79

FGA FLOOD WAVE ROUTING

APPROXIMATE FLOOD WAVE ROUTING BASED UPON U.S. ARMY CORPS OF ENGINEERS' "RULE OF THUMB GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS" DATED APRIL, 1978.

INITIAL STATION = 0 +0
INITIAL WAVE HEIGTH = 23.0 FT
ASSUMED BREACH WIDTH = 240.0 FT
INITIAL RESERVOIR STORAGE = 3,061 ACRE-FT
COMPUTED FLOOD WAVE PEAK FLOW = 44,482 CFS

STATION 1 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-800.0 FT	290.0 FT	-750.0 FT	280.0 FT	-400.0 FT	270.0 FT
-260.0 FT	260.0 FT	-130.0 FT	250.0 FT	-80.0 FT	240.0 FT
-10.0 FT	239.0 FT				
		N = 0.080			
-10.0 FT	239.0 FT	-5.0 FT	237.0 FT	5.0 FT	237.0 FT
10.0 FT	239.0 FT				
		N = 0.100			
10.0 FT	239.0 FT	410.0 FT	240.0 FT	500.0 FT	250.0 FT
570.0 FT	260.0 FT	870.0 FT	270.0 FT	1210.0 FT	290.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
834.0 SF	114.4 FT	0.100	7.9 FPS	6,589CFS
224.1 SF	20.7 FT	0.080	12.8 FPS	2,875CFS
4,024.0 SF	478.8 FT	0.100	8.6 FPS	34,954CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
237.0 FT	11.7 FT	248.7 FT	5,082 SF	8.7 FPS	44,419 CFS	0.0200

STATION 10+70

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-500.0 FT	270.0 FT	-350.0 FT	260.0 FT	-230.0 FT	250.0 FT
-50.0 FT	220.0 FT	-10.0 FT	219.0 FT		
		N = 0.080			
-10.0 FT	219.0 FT	-5.0 FT	217.0 FT	5.0 FT	217.0 FT
10.0 FT	219.0 FT				
		N = 0.100			
10.0 FT	219.0 FT	80.0 FT	220.0 FT	300.0 FT	220.0 FT
390.0 FT	230.0 FT	630.0 FT	230.0 FT	850.0 FT	240.0 FT
1020.0 FT	250.0 FT	1440.0 FT	250.0 FT	1800.0 FT	260.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
851.6 SF	108.5 FT	0.100	8.5 FPS	7,240CFS
275.3 SF	20.7 FT	0.080	15.0 FPS	4,151CFS
4,188.7 SF	648.4 FT	0.100	7.4 FPS	31,285CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
217.0 FT	14.2 FT	231.2 FT	5,315 SF	8.0 FPS	42,677 CFS	0.0210

STATION 16+80

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-880.0 FT	240.0 FT	-310.0 FT	240.0 FT	-70.0 FT	210.0 FT
-10.0 FT	209.0 FT				
		N = 0.080			
-10.0 FT	209.0 FT	-5.0 FT	207.0 FT	5.0 FT	207.0 FT
10.0 FT	209.0 FT				
		N = 0.100			
10.0 FT	209.0 FT	220.0 FT	210.0 FT	300.0 FT	220.0 FT
750.0 FT	230.0 FT	990.0 FT	250.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,370.1 SF	159.0 FT	0.100	7.8 FPS	10,823CFS
295.6 SF	20.7 FT	0.080	13.7 FPS	4,079CFS
3,383.4 SF	393.2 FT	0.100	7.8 FPS	26,701CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
207.0 FT	15.2 FT	222.2 FT	5,049 SF	8.2 FPS	41,604 CFS	0.0160

STATION 29+60

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-870.0 FT	230.0 FT	-620.0 FT	210.0 FT	-470.0 FT	190.0 FT
-10.0 FT	186.0 FT				
		N = 0.080			
-10.0 FT	186.0 FT	-5.0 FT	184.0 FT	5.0 FT	184.0 FT
10.0 FT	186.0 FT				
		N = 0.100			
10.0 FT	186.0 FT	200.0 FT	190.0 FT	250.0 FT	200.0 FT
470.0 FT	210.0 FT	710.0 FT	220.0 FT	980.0 FT	230.0 FT
1120.0 FT	240.0 FT				

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
3,553.3 SF	501.4 FT	0.100	7.3 FPS	26,134CFS
219.5 SF	20.7 FT	0.080	12.0 FPS	2,636CFS
1,496.2 SF	217.9 FT	0.100	7.2 FPS	10,773CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
184.0 FT	11.4 FT	195.4 FT	5,269 SF	7.5 FPS	39,544 CFS	0.0180

STATION 43+50

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-620.0 FT	230.0 FT	-410.0 FT	200.0 FT	-200.0 FT	170.0 FT
-50.0 FT	160.0 FT	-10.0 FT	160.0 FT		
		N = 0.080			
-10.0 FT	160.0 FT	-5.0 FT	158.0 FT	5.0 FT	158.0 FT
10.0 FT	160.0 FT				
		N = 0.100			
10.0 FT	160.0 FT	200.0 FT	160.0 FT	400.0 FT	170.0 FT
500.0 FT	180.0 FT	710.0 FT	190.0 FT	900.0 FT	230.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,258.9 SF	194.3 FT	0.100	7.1 FPS	8,960CFS
241.3 SF	20.7 FT	0.080	13.1 FPS	3,170CFS
3,122.8 SF	395.9 FT	0.100	8.1 FPS	25,344CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
158.0 FT	12.5 FT	170.5 FT	4,623 SF	8.1 FPS	37,475 CFS	0.0190

STATION 63 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-800.0 FT	150.0 FT	-600.0 FT	130.0 FT	-10.0 FT	124.0 FT
		N = 0.080			
-10.0 FT	124.0 FT	-5.0 FT	122.0 FT	5.0 FT	122.0 FT
10.0 FT	124.0 FT				
		N = 0.100			
10.0 FT	124.0 FT	400.0 FT	130.0 FT	510.0 FT	150.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
3,216.9 SF	614.1 FT	0.100	6.0 FPS	19,343CFS
198.0 SF	20.7 FT	0.080	11.2 FPS	2,219CFS
2,123.2 SF	403.4 FT	0.100	6.0 FPS	12,806CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
122.0 FT	10.4 FT	132.4 FT	5,538 SF	6.2 FPS	34,369 CFS	0.0180

STATION 77+50

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-220.0 FT	150.0 FT	-70.0 FT	110.0 FT	-10.0 FT	107.0 FT
		N = 0.080			
-10.0 FT	107.0 FT	-5.0 FT	105.0 FT	5.0 FT	105.0 FT
10.0 FT	107.0 FT				
		N = 0.100			
10.0 FT	107.0 FT	130.0 FT	110.0 FT	210.0 FT	120.0 FT
300.0 FT	150.0 FT				

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,167.1 SF	109.8 FT	0.100	7.8 FPS	9,184CFS
346.3 SF	20.7 FT	0.080	13.2 FPS	4,600CFS
2,355.5 SF	209.5 FT	0.100	8.1 FPS	19,240CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
105.0 FT	17.8 FT	122.8 FT	3,869 SF	8.5 FPS	33,024 CFS	0.0120

STATION 94 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-750.0 FT	100.0 FT	-210.0 FT	100.0 FT	-100.0 FT	90.0 FT
-10.0 FT	82.0 FT				
		N = 0.080			
-10.0 FT	82.0 FT	-5.0 FT	80.0 FT	5.0 FT	80.0 FT
10.0 FT	82.0 FT				
		N = 0.100			
10.0 FT	82.0 FT	100.0 FT	90.0 FT	170.0 FT	100.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
2,338.6 SF	740.8 FT	0.100	3.9 FPS	9,159CFS
404.2 SF	20.7 FT	0.080	16.4 FPS	6,655CFS
1,724.3 SF	161.0 FT	0.100	8.8 FPS	15,243CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
80.0 FT	20.7 FT	100.7 FT	4,467 SF	6.9 FPS	31,058 CFS	0.0150

STATION 110+50

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-320.0 FT	70.0 FT	-100.0 FT	50.0 FT	-30.0 FT	40.0 FT
-10.0 FT	37.0 FT				
		N = 0.080			
-10.0 FT	37.0 FT	-5.0 FT	35.0 FT	5.0 FT	35.0 FT
10.0 FT	37.0 FT				
		N = 0.100			
10.0 FT	37.0 FT	40.0 FT	50.0 FT	270.0 FT	100.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,471.8 SF	167.7 FT	0.100	10.3 FPS	15,288CFS
429.0 SF	20.7 FT	0.080	22.9 FPS	9,859CFS
514.8 SF	65.4 FT	0.100	9.6 FPS	4,973CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
35.0 FT	21.9 FT	56.9 FT	2,415 SF	12.4 FPS	30,121 CFS	0.0270

STATION 161 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-200.0 FT	-50.0 FT	-150.0 FT	-60.0 FT	-30.0 FT	-70.0 FT
-10.0 FT	-70.0 FT				
		N = 0.080			
-10.0 FT	-70.0 FT	-5.0 FT	-72.0 FT	5.0 FT	-72.0 FT
10.0 FT	-70.0 FT				
		N = 0.100			
10.0 FT	-70.0 FT	380.0 FT	-50.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,229.4 SF	155.2 FT	0.100	8.5 FPS	10,517CFS
288.3 SF	20.7 FT	0.080	15.5 FPS	4,482CFS
1,543.0 SF	239.2 FT	0.100	7.4 FPS	11,512CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
-72.0 FT	14.9 FT	-57.0 FT	3,060 SF	8.6 FPS	26,512 CFS	0.0210

STATION 189 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-600.0 FT	50.0 FT	-370.0 FT	-50.0 FT	-170.0 FT	-100.0 FT
-70.0 FT	-110.0 FT	-10.0 FT	-114.0 FT		
		N = 0.080			
-10.0 FT	-114.0 FT	-5.0 FT	-116.0 FT	5.0 FT	-116.0 FT
10.0 FT	-114.0 FT				
		N = 0.100			
10.0 FT	-114.0 FT	410.0 FT	-100.0 FT	600.0 FT	-50.0 FT

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
1,144.2 SF	155.8 FT	0.100	5.7 FPS	6,583CFS
300.3 SF	20.7 FT	0.080	11.2 FPS	3,393CFS
2,611.1 SF	386.5 FT	0.100	5.4 FPS	14,208CFS

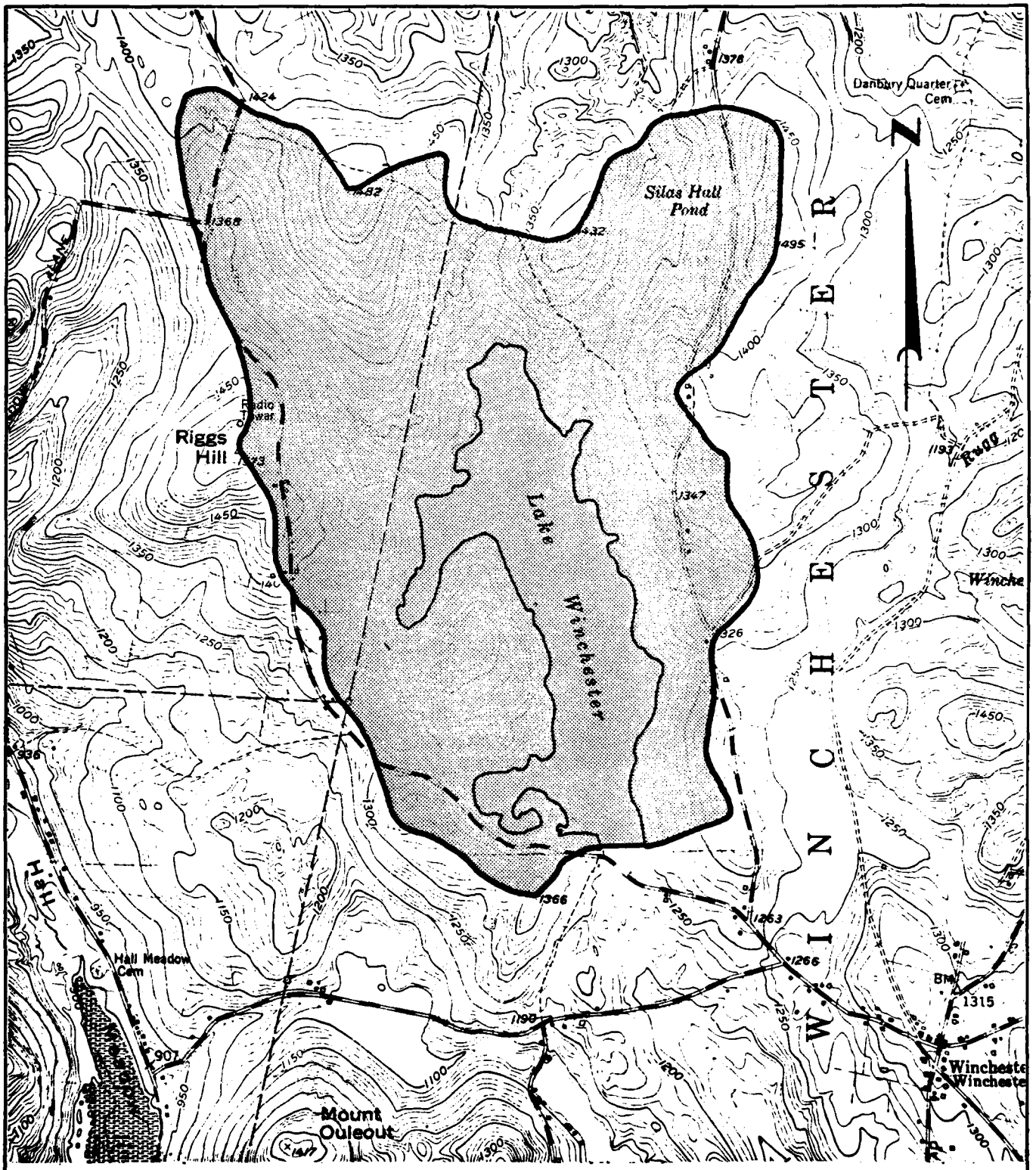
INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
-116.0 FT	15.5 FT	-100.4 FT	4,055 SF	5.9 FPS	24,185 CFS	0.0105

STATION 215 +0

OFFSET	ELEV.	OFFSET	ELEV.	OFFSET	ELEV.
		N = 0.100			
-700.0 FT	-80.0 FT	-600.0 FT	-100.0 FT	-400.0 FT	-120.0 FT
-250.0 FT	-129.0 FT				
		N = 0.080			
-250.0 FT	-129.0 FT	350.0 FT	-129.0 FT		
		N = 0.100			
350.0 FT	-129.0 FT	500.0 FT	-110.0 FT		

AREA	WETTED PERIMETER	N	VELOCITY	FLOW
414.0 SF	117.6 FT	0.100	2.4 FPS	1,006CFS
4,229.1 SF	600.0 FT	0.080	4.8 FPS	20,420CFS
196.1 SF	56.0 FT	0.100	2.4 FPS	474CFS

INVERT	DEPTH	W. SURFACE	AREA	VELOCITY	FLOW	SLOPE
-129.0 FT	7.0 FT	-121.9 FT	4,839 SF	4.5 FPS	21,901 CFS	0.0050



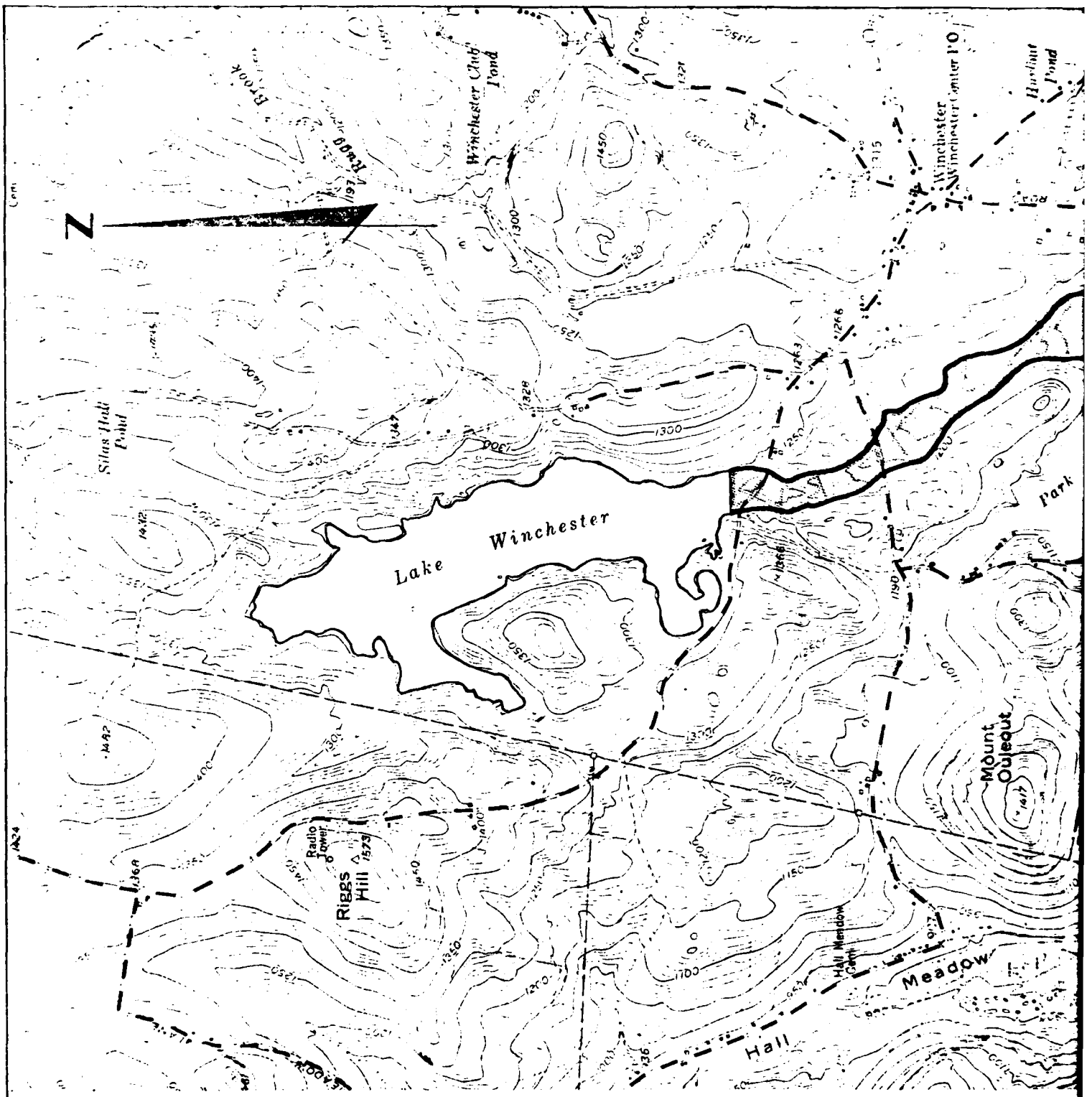
WINCHESTER LAKE DAM

DRAINAGE MAP

WINCHESTER, CONNECTICUT

FLAHERTY • GIAVARA ASSOCIATES, P.C.

D-21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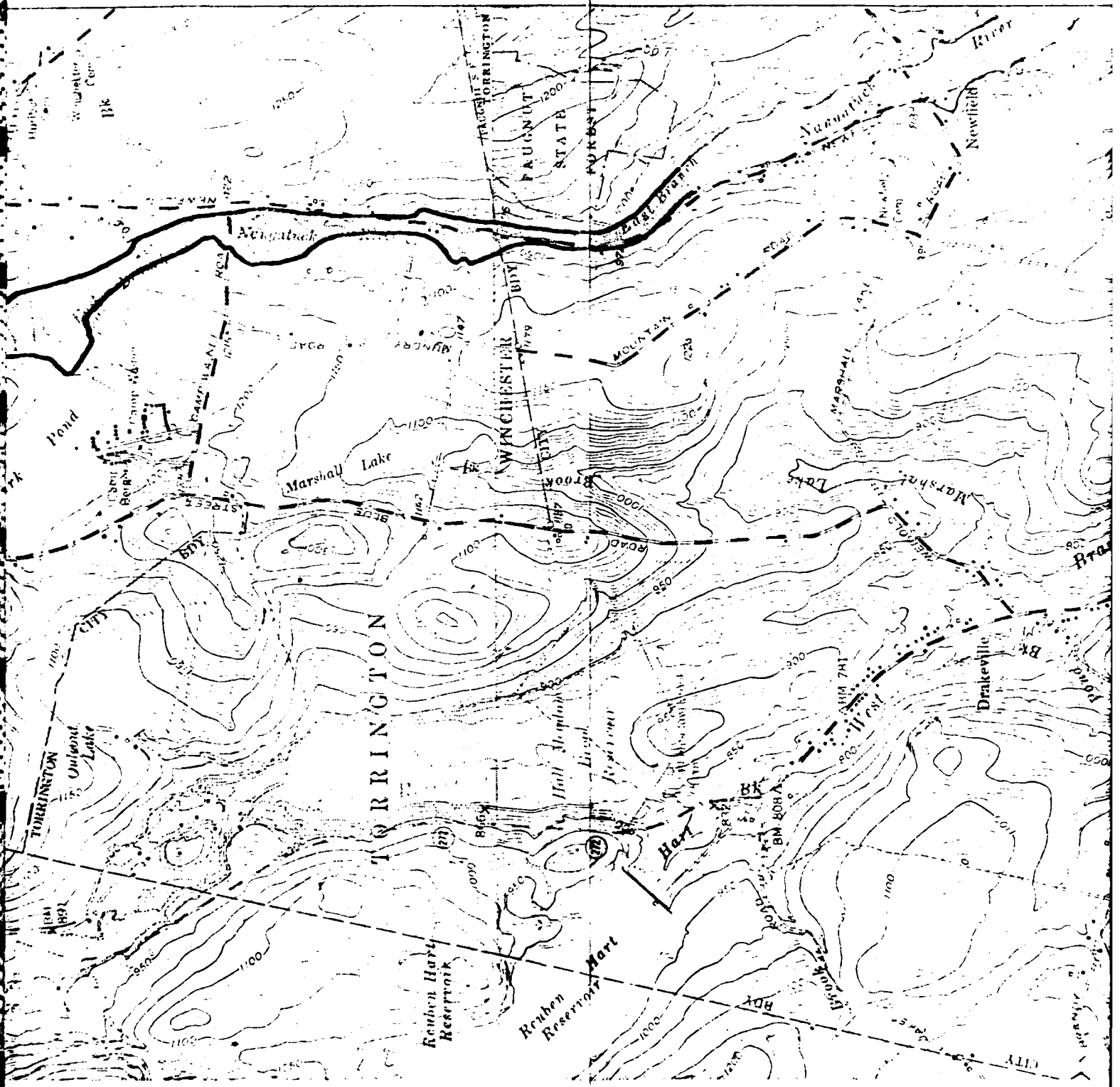
Winchester Club Pond
Winchester
Winchester Center P.O.
Hurlbut Pond
Silas Hall Pond
Lake Winchester
Park
Mount Oulequt
Riggs Hill
Radio Tower
Hall Meadow
Meadow
Hall
SCALE IN FEET
2000 1000 0 2000



WINCHESTER LAKE DAM

DAM FAILURE ANALYSIS

IMPACT AREAS

WINCHESTER , CONNECTICUT

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

8

DTIC